

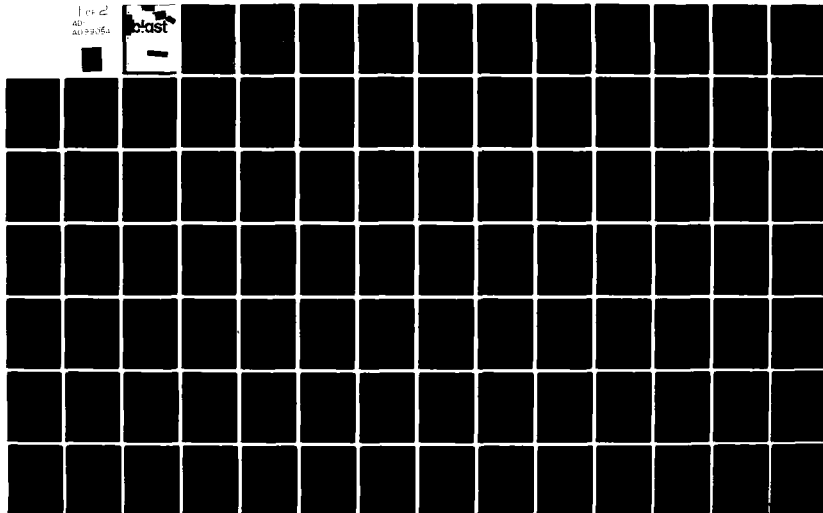
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CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAIGN IL F/G 9/2  
BUILDING LOADS ANALYSIS AND SYSTEM THERMODYNAMICS (BLAST) PROGR--ETC(U)  
MAR 81 D HERRON, G WALTON, L LAWRIE FY7615-79-05134  
CERL-TR-E-171-VOL-1 NL

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systems, (11) induction unit systems, (12) direct-drive chillers, and (13) purchased steam from utilities. BLAST Version 3.0 also offers the user a generalized report writer and several new output report options not available from BLAST Version 2.0.

Although the simulation capabilities of BLAST Version 3.0 are expanded over BLAST Version 2.0, users familiar with BLAST Version 2.0 can use Version 3.0 without modifying their approach or their BLAST input.

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## FOREWORD

This report was prepared for the Air Force Systems Command (AFSC), Aeronautical Systems Division (ASD), Wright-Patterson Air Force Base, OH, under MIPR FY7615-79-05134, and the Department of Energy (DOE), Division of Conservation and Solar Applications, under DE-AI01-79CS30301. The Air Force Technical Monitor was MAJ W. C. Rosenthal. The DOE Technical Monitor was Dr. Ron Kammarud.

The revisions to BLAST Version 2.0 leading to BLAST 3.0 described in this report were done by Mr. Dale Herron and Mr. George Walton of the Energy Systems (ES) Division and Ms. Linda Lawrie and Ms. Jean Baugh of the Computer Support Office (SOC) of the U.S. Army Construction Engineering Research Laboratory (CERL).

Administrative support was provided by Mr. D. C. Hittle, Dr. D. J. Leverenz, and Mr. R. G. Donaghy, Chief of CERL-ES. Ms. M. L. Scala was the consulting editor.

COL Louis J. Circeo is Commander and Director of CERL and Dr. L. R. Shaffer is Technical Director.

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BUILDING LOADS ANALYSIS AND SYSTEM THERMODYNAMICS  
(BLAST) PROGRAM USERS MANUAL -- VOLUME ONE SUPPLEMENT  
(VERSION 3.0)

## 1 INTRODUCTION

### Background

The Building Loads Analysis and System Thermodynamics (BLAST) computer program is a comprehensive set of subprograms for predicting energy consumption and energy systems performance and cost in buildings. BLAST Version 2.0, which was released for public use in June 1979, contains most of the simulation capabilities required to analyze the energy performance of buildings.<sup>1</sup> However, BLAST Version 2.0 was not well suited to studying passive solar applications or to analyzing large-scale industrial facilities. Because of this, BLAST's simulation capabilities were expanded and BLAST Version 3.0 was created.

New or revised simulation capabilities incorporated in BLAST Version 3.0 include:

- Expanded scheduling options
- New output report options
- Generalized report writer
- Interzone heat transfer/ventilation
- Movable insulation
- Daylighting
- Exact internal solar distribution
- Radiant temperature control
- Exterior radiant interchange
- Mechanical ventilation
- Process heat as heat source
- Latent air-to-air heat recovery
- Water-cooled packaged systems
- Induction unit systems
- Direct-drive chillers
- Evaporative and well-water condensers
- Purchased steam from utilities
- Expanded weather processing program

Although BLAST Version 3.0 expands the simulation capabilities of BLAST Version 2.0, users familiar with BLAST Version 2.0 can use BLAST Version 3.0 without modifying their approach or their BLAST input. The BLAST Version 3.0 Input Language allows, in some cases, two ways of specifying an input. For example, to take advantage of the new scheduling option in BLAST Version 3.0, the user must input the schedules according to the format described in this

<sup>1</sup> D. C. Hittle, The Building Loads Analysis and System Thermodynamics (BLAST) Program, Users Manual, Volumes I and II, Technical Report (TR) E-153/ADA072272 and ADA072273 (U.S. Army Construction Engineering Research Laboratory [CERL], June 1979).

booklet. If the user wishes, however, he\* may use the BLAST scheduling capabilities as described in the BLAST Version 2.0 Users Manual by specifying the schedules in the Version 2.0 format.

In two cases, the BLAST Version 2.0 input command may not be allowed in BLAST Version 3.0. If one of these commands is input, a warning message stating that this command is no longer applicable to BLAST Version 3.0 will be issued. The two cases are (1) the specification of heating and cooling seasonal operation within the DEFINE CONTROLS section of the lead input block, and (2) the EQUIPMENT ASSIGNMENT section of the plant input block.

### Scope

This instruction booklet is a supplement to the BLAST Version 2.0 Users Manual; it explains to those familiar with BLAST Version 2.0 how to exercise the additional simulation capabilities of BLAST Version 3.0. However, an understanding of the material in this report is not required to use BLAST Version 3.0. Every effort has been made to ensure that the instructions given in the BLAST Version 2.0 Users Manual apply to BLAST Version 3.0. This booklet is only for users interested in BLAST Version 3.0's additional capabilities.

Beginning BLAST users should obtain a copy of the BLAST Version 2.0 Users Manual and become thoroughly familiar with it before attempting to use this instruction booklet.

### Instruction Booklet Outline

Chapter 2 updates the sample input deck given in Chapter 2 of the BLAST Version 2.0 Users Manual. Chapter 3 details Version 3.0's additions to Version 2.0 lead input data. Chapter 4 lists new building description input and describes the expanded simulation capabilities of the loads subprogram. Chapter 5 lists Version 3.0 system description input and explains the additional capabilities of the fan system simulation subprogram. Chapter 6 gives Version 3.0 additions to the central plant description and describes the new capabilities of the plant simulation subprogram. Appendix A describes how to use the WIFE program; Appendix B describes how to use the BLAST Report Writer.

---

\* The male pronoun is used throughout this booklet to refer to both genders.

A simple input deck for the BLAST program is shown in Figure 1. This is a new version of the sample deck shown in Chapter 2 of the BLAST Version 2.0 Users Manual. Note that the Version 2.0 sample deck will also be correct for BLAST Version 3.0; Figure 1 lists some of the new language which is allowed for BLAST Version 3.0. This example is not intended to illustrate all the features of BLAST; users must consult the BLAST Version 2.0 Users Manual and the remainder of this booklet for complete instructions.

```
BEGIN INPUT;
RUN CONTROL:
  NEW ZONES, NEW SYSTEMS, PLANT,
  REPORTS(ZONE,ZONE LOADS,WALLS,
          SYSTEM,SYSTEM LOADS,COIL LOADS,
          EQUIPMENT PARAMETERS,PLANT LOADS),
  UNITS(ENGLISH);
DEFINE FLOORS:
  SLAB = (DIRT 12 IN,CONCRETE - SAND AND GRAVEL 4 IN,
          FINISH FLOORING - CARPET RUBBER PAD);
  END;
DEFINE LOCATION:
  COLUMBIA = (LAT=38.9,LONG=92.3,TZ=6);
  END;
DEFINE DESIGN DAYS:
  COLUMBIA SUMMER = (HIGH=95,LOW=73,WB=78,DATE=21JUL,
                    PRES=405,WFDNESDAY,CLEARNESS=.95),
  COLUMBIA WINTER=(HIGH=26,LOW=6,WB=25,DATE=21JAN,
                  PRES=405,SATURDAY);
  END;
PROJECT = "WORKSHOP OFFICE MODULE";
DESIGN DAYS = COLUMBIA SUMMER, COLUMBIA WINTER;
WEATHER TAPE FROM 01JAN THRU 31DEC;
LOCATION=COLUMBIA;
GROUND TEMPERATURES = (40,42,48,55,62,67,70,69,63,55,48,42);
MAKE UP WATER TEMPERATURES = (50,52,54,58,60,62,60,58,57,55,53,51);
```

Figure 1. Version 3.0 sample input deck.

\*Numbers in parentheses are the pages in the BLAST Version 2.0 Users Manual on which the material under the section heading in this booklet is discussed.

BEGIN BUILDING DESCRIPTION;

DIMENSIONS:

WIDTH1=12.,HEIGHT1=8., WIDTH2=8.,HEIGHT2 = 4.,WIDTH3 = 24.;

BUILDING = "NEW OFFICE WEST WING";

NORTH AXIS = 0;

ZONE 1 "LEFT END UNIT":

ORIGIN:(0,0,0);

NORTH AXIS = 0;

EXTERIOR WALLS:

STARTING AT (0,0,0) FACING (180)

EXTWALLO4 (WIDTH1 BY HEIGHT1)

WITH WINDOWS OF TYPE

SINGLE PANE HW WINDOW (WIDTH2 BY HEIGHT2)

AT (2,2)

WITH OVERHANG (WIDTH1 BY 3)

AT (0, HEIGHT1),

STARTING AT (0,25,0) FACING(270)

EXTWALLO4 (25 BY HEIGHT1);

PARTITIONS:

STARTING AT (WIDTH1,0,0) FACING (90)

PARTITION18 (25 BY HEIGHT1),

STARTING AT (WIDTH1,25,0) FACING (0)

PARTITION18 (WIDTH1 BY HEIGHT1);

ROOF:

STARTING AT (0,0,HEIGHT1) FACING (180)

ROOF04 (WIDTH1 BY 25);

SLAB ON GRADE FLOOR:

STARTING AT (0,25,0) FACING (180)

SLAB (WIDTH1 BY 25);

PEOPLE = 2, OFFICE OCCUPANCY;

LIGHTS = 1.7, OFFICE LIGHTING;

INFILTRATION = 20., CONSTANT;

CONTROLS = NIGHT AND WEEKEND SETBACK WITH SINGLE THROTTLING RANGE,  
8 COOLING, 16 HEATING;

END ZONE;

ZONE 2 " LOWER MIDDLE UNIT ":

ORIGIN: (WIDTH1,0,0);

NORTH AXIS = 0;

Figure 1. (Cont'd).

SAME AS ZONE 1 EXCEPT:

EXTERIOR WALLS:

STARTING AT (0,0,0) FACING (180)  
EXTWALLO4 (WIDTH1 BY HEIGHT1)  
WITH WINDOWS OF TYPE  
SINGLE PANE HW WINDOW (WIDTH2 BY HEIGHT2)  
AT (2,2)  
WITH OVERHANG (WIDTH1 BY 3)  
AT (0, HEIGHT1);

PARTITIONS:

STARTING AT (WIDTH1,25,0) FACING (0)  
PARTITION18 (WIDTH1 BY HEIGHT1),  
STARTING AT (WIDTH1,0,0) FACING (90)  
PARTITION18 (25 BY HEIGHT1),  
STARTING AT (0,25,0) FACING(270)  
PARTITION18 (25 BY HEIGHT1);

END ZONE;

ZONE 3 " UPPER MIDDLE UNIT " :

ORIGIN: (WIDTH3, 55, 0);  
NORTH AXIS = 180;  
SAME AS ZONE 2 EXCEPT:  
END ZONE;

ZONE 4 "UPPER OUTSIDE UNIT":

ORIGIN:(WIDTH1,55,0);  
NORTH AXIS =180;  
SAME AS ZONE 1 EXCEPT:  
EXTERIOR WALLS:  
STARTING AT (0,0,0) FACING (180)  
EXTWALLO4 (WIDTH1 BY HEIGHT1)  
WITH WINDOWS OF TYPE  
SINGLE PANE HW WINDOW (WIDTH2 BY HEIGHT2)  
AT (2,2),  
STARTING AT (WIDTH1,0,0) FACING (90)  
EXTWALLO4 (25 BY HEIGHT1);

PARTITIONS:

STARTING AT (0,25,0) FACING (270)

Figure 1. (Cont'd).

```

    PARTITION18 (25 BY HEIGHT1),
    STARTING AT (WIDTH1,25,0) FACING (0)
    PARTITION18 (WIDTH1 BY HEIGHT1);
END ZONE;
END BUILDING DESCRIPTION;
BEGIN FAN SYSTEM DESCRIPTION;
MULTIZONE SYSTEM 72 "MAIN" SERVING ZONES 1,2,3,4;
  FOR ZONE 1:
    SUPPLY AIR VOLUME=500.;
  END;
  FOR ZONE 2:
    SUPPLY AIR VOLUME=500.;
  END;
  FOR ZONE 3:
    SUPPLY AIR VOLUME=500.;
  END;
  FOR ZONE 4:
    SUPPLY AIR VOLUME=500.;
  END;
END SYSTEM;
END FAN SYSTEM DESCRIPTION;
BEGIN CENTRAL PLANT DESCRIPTION;
PLANT 4 "MAIN PLANT" SERVING SYSTEM 72;
EQUIPMENT SELECTION:
  CHILLER:
    1 OF SIZE 160;
  BOILER:
    1 OF SIZE 160;
  END;
END PLANT;
END CENTRAL PLANT DESCRIPTION;

END INPUT;

```

Figure 1. (Cont'd).



### 3 LEAD INPUT

BLAST Version 3.0 makes several changes and additions to the BLAST Version 2.0 lead input data block:

1. Additional optional report names have been added to the REPORTS command.
2. The PRINT LIBRARY command has been expanded to allow user-specified sections of the library to be printed.
3. The format for defining several of the library sections has been expanded to include special day types.
4. The project parameters section has been expanded to include MAKE UP WATER TEMPERATURES.

#### Program Control

(40,41)

The REPORTS subcommand of the RUN CONTROL input command now accepts the following additional optional report names:

ZONE LOADS

SYSTEM LOADS

PLANT LOADS

Examples of these reports can be found in Chapters 4, 5, and 6, respectively.

The PRINT LIBRARY command has been expanded to allow printing of both selected sections of the BLAST library and of the entire library. The command for printing the entire library is still:

#### PRINT LIBRARY

The command for printing specific sections of the library is:

PRINT LIBRARY (secname1,secname2...,secnameN)

where secname is chosen from the following library section names:

SCHEDULE  
LOCATION  
DESIGN DAYS  
CONTROLS  
MATERIALS  
WALLS

ROOFS  
FLOORS  
DOORS  
WINDOWS  
PASSIVE CONTROLS

### Library Modification

(3,29,33-39)

The format for defining elements in the DESIGN DAYS, SCHEDULES, and CONTROLS sections of the BLAST library has been expanded to include up to four special days. Special days allow greater flexibility in scheduling loads, occupancy, etc. by allowing the user to input specific schedules for unusual days. For design day simulations, the user can specify the special day in the design day definition. For weather period simulations, the user selects the appropriate special days when the weather file to be used for the simulation is created using the WIFE program (see Appendix A).

### Design Days

(3,29,33-35)

The format for DEFINE DESIGN DAYS is unchanged; however, the user now has greater flexibility in selecting the day type. Allowable day types are any one of WEEKDAY, WEEKEND, HOLIDAY, SUNDAY, MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY, SPECIAL1, SPECIAL2, SPECIAL3, and SPECIAL4. (Schedules and control strategies for MONDAY are used if WEEKDAY is selected and for SUNDAY if WEEKEND is selected.)

### General Schedules

(3,29,36-37)

Schedules define 24-hour profiles for (1) each day of the week, (2) holidays, and (3) special days. These schedules are then used to describe (1) lighting, occupancy, equipment, and infiltration profiles for the zone, (2) equipment operation and ventilation profiles of building systems, and (3) scheduled load profiles of building plants. Because of the addition of special days and because schedules are now used in the fan system and central plant description, the format of the schedule definition has been expanded. Four more day types are now allowed: SPECIAL1, SPECIAL2, SPECIAL3, and SPECIAL4. Each of the four special days must be specified separately (for example, FRIDAY THRU SPECIAL4 is not allowed), and special days may be equated to other day types. An example of a schedule definition using special days is:

DEFINE SCHEDULE (NEWSCHED):

```
MONDAY THRU FRIDAY = (18 to 07 - .4, 07 to 18 - .9),  
SATURDAY THRU SUNDAY = (00 to 24 - .1),  
HOLIDAY = SUNDAY,  
SPECIAL1 = (00 to 24 - 0),  
SPECIAL3 = MONDAY,  
SPECIAL4 = (18 to 07 - 1., 07 TO 18 - .9);
```

END SCHEDULE;

If profiles for any of SPECIAL1, SPECIAL2, SPECIAL3, or SPECIAL4 are not specified, they default to the HOLIDAY profiles.

Because the command SCHEDULES is now also used to specify the on/off operation of equipment, the words ON and OFF are now equivalent to 1. and 0., respectively, in the profile definition. For example, specifying

MONDAY = (08 to 17 - 1., 17 to 08 - 0.),

is equivalent to specifying

MONDAY = (08 to 17 - ON, 17 to 08 - OFF),

### Control Strategies

(3,29,37-39)

The allowable day types for the control strategy definition have been expanded to include SPECIAL1, SPECIAL2, SPECIAL3, and SPECIAL4. In addition, the specification for seasonal availability of heating and cooling has been deleted from the control definition. Users must now specify different control profiles for different portions of the year by repeating the CONTROL statement for different control definitions in the zone description to specify seasonal availability of heating and cooling (see Chapter 4 for details). An example of a complete control definition is:

DEFINE CONTROLS (CONTROLS):

PROFILES:

HEATANDCOOL = (1.0 AT 67, 0.0 AT 69, 0.0 AT 77, -1.0 AT 79),  
SETBACK = (1.0 AT 55, 0.0 AT 58);

SCHEDULES:

MONDAY THRU FRIDAY = (07 to 18 - HEATANDCOOL, 18 to 07 - SETBACK),  
SATURDAY THRU SUNDAY = (00 to 24 - SETBACK),  
HOLIDAY = SUNDAY,  
SPECIAL1 = (00 to 24 - HEATANDCOOL),  
SPECIAL2 = (07 TO 12 - HEATANDCOOL, 12 TO 07 - SETBACK),  
SPECIAL3 = MONDAY,  
SPECIAL4 = SPECIAL1;

END CONTROLS;

### Passive Controls

(Not in the BLAST Version 2.0 Users Manual)

A passive controls section has been added to the BLAST library to let the user describe the operation of several passive control features, including outside movable insulation, inside movable insulation, and solar walls.

The general form of the passive control definition is:

DEFINE PASSIVE CONTROLS:

```
    usname1 = (keyword);
    usname2 = (keyword);
    .
    .
    .
    usnamen = (keyword);
END PASSIVE CONTROLS;
```

where:

usname1...n = user-supplied name  
keyword = any one of the following:

```
SUNUP
SUNDOWN
MAX GAIN
MAX LOSS
MAINTAIN usn
VENT IN
VENT OUT
VENT usn
```

SUNUP and SUNDOWN are keywords which describe systems that are operating when the sun is up or down, respectively. The controls defined with them are used only with outside movable insulation.

MAX GAIN and MAX LOSS describe systems operating to give the maximum heat gain into and the maximum heat loss out from the zone, respectively. MAINTAIN usn describes a system that gives a heat gain or loss which attempts to maintain temperature usn. Controls defined by these keywords are used only with inside movable insulation.

VENT IN, VENT OUT, and VENT usn are used with the air channel of solar walls. VENT IN allows outside air to be convected into the room. VENT OUT allows room air to be convected to the outside. VENT usn allows natural convection which attempts to maintain the room at temperature usn. Convection will occur only if the air channel temperature is greater than the temperature of the source air. Back flow is not permitted.

Instead of keywords, the user may define passive controls in terms of a 24-hour profile using the general schedule syntax. Profile elements must be between zero and one. For movable insulation, the profile element is a multiplier of the user-given R-value of the insulation. Reducing the R-value to zero means no insulation for that hour. The schedule hour refers to (1) standard time for outside insulation, (2) clock time for inside insulation. When a schedule is applied to air channel convection, it reduces the flow rate according to the schedule element for the clock time hour.

The following is an example of a passive controls definition:

DEFINE PASSIVE CONTROLS:

```
SUNUP = (SUNUP);  
SD = (SUN DOWN);  
LOSS = (MAX LOSS);  
GAIN = (MAX GAIN);  
MT70 = (MAINTAIN 70);  
VTIN = (VENT IN);  
VTOUT = (VENT OUT);  
VT65 = (VENT 65);  
SCHED = (07 TO 12 - 0, 12 TO 07 - 1.0);
```

END PASSIVE CONTROLS;

#### Project Parameters

(40,41)

To increase program flexibility, the WEATHER TAPE command has been modified to make specification of the year optional. Specifying

```
WEATHER TAPE FROM 01FEB THRU 31MAR;
```

is now identical to specifying

```
WEATHER TAPE FROM 01FEB65 THRU 31MAR65;
```

for a weather tape for calendar year 1965.

Specification of the supply temperature of makeup water to the building, system, and plant has been included. The format of the command is similar to the GROUND TEMPERATURES command. For example:

```
MAKE UP WATER TEMPERATURES = (50,51,53,54,56,58,58,57,55,53,52,51);
```

The default water temperature if MAKE UP WATER TEMPERATURES are not specified is 55°F (12.8°C) for each month.

#### 4 BUILDING DESCRIPTION

Although BLAST Version 3.0 makes significant changes to the way the BLAST program calculates zone loads, the user will still prepare building and zone description input decks in almost exactly the same way as described in the BLAST Version 2.0 Users Manual. The changes required to prepare input decks for BLAST Version 3.0 are made to give the user access to Version 3.0's additional capabilities.

##### Zone Heat Balance

(26,27)

The zone heat balance has been modified to use a mean radiant temperature technique. This new method should give more accurate results by allowing zone loads to be calculated simultaneously rather than individually. Because of array dimension limits, the user should simulate no more than 20 zones and not more than 240 heat transfer surfaces in any one run. The user should describe multiple buildings with a maximum of 20 zones per BUILDING DESCRIPTION or use ADD ZONES runs when it is necessary to have a larger building loads file.

##### New Surface Types

(4-5,50-60,64-65,71-72,76)

The following three surfaces have been added to the list of allowable surface types:

INTERZONE PARTITION:  
INTERZONE CEILING:  
INTERZONE FLOOR:

The interzone surfaces separate zones which are being modeled simultaneously. The three types have different default tilts: 90°, 0°, and 180°, respectively. Each interzone surface must include the expression "ADJACENT TO ZONE (usn)", where usn is the zone number. When that zone is described, it must include an interzone surface adjacent to the first zone. It may be necessary to use different wall sections if the wall layers are not symmetric; wall sections are defined starting at the outside layer. Two adjacent zones refer to different "outsides." Thermal capacitance effects are fully accounted for in the BLAST interzone calculations.

More accurate loads will usually be calculated when attics and crawl spaces are modeled as zones at the same time as occupied zones and are connected by interzone surfaces rather than by attic and crawlspace zones.

##### Wings and Overhangs

(4,51-59)

The syntax for wings and overhangs has been expanded as follows:  
WITH OVERHANG (or WING) (usn1 BY usn2) AT (usn3, usn4)  
TRANS (usn5) FROM date1 THRU date2

TRANS defines the transmittance of the overhang or wing. The default is zero, which is opaque. Totally transparent is 1. The dates allow seasonal

scheduling of these shading features. Program execution will be faster if start and stop dates are chosen from the following list:

START DATES	STOP DATES
1 Jan	31 Jan
1 Feb	20 Feb
21 Feb	23 Mar
13 Mar	31 Mar
1 Apr	20 Apr
21 Apr	15 May
16 May	31 Jul
1 Aug	24 Aug
25 Aug	12 Sep
13 Sep	30 Sep
1 Oct	20 Oct
21 Oct	15 Nov
16 Nov	15 Dec
16 Dec	31 Dec

Shadow patterns are normally computed for the 14 time periods above. Shading features which do not use these dates will increase the number of time periods. A shading feature may commonly occur over several time periods, e.g. FROM 16MAY THRU 30SEP.

#### Simplified Zone Geometry Description

(4,31-33,51-60,71-72,76-77)

When shading of windows and walls has a significant effect on zone loads, the building's geometry must be carefully described. However, there are many cases in which the load can be adequately calculated without considering shading. The following command placed before the first zone description will allow a simpler description of zone geometry:

SOLAR DISTRIBUTION = - 1;

When this command is in effect for the building, detached shading surfaces and zone walls have no effect on shading. It is therefore possible to remove the phrase "STARTING AT (usn, usn, usn)" from all surface descriptions. The shading effects of wings and overhangs on walls and windows are unchanged.

#### Detailed Zone Geometry Description

(4,21-33,51-60,71-72,76-77)

When it is expected that loads will be affected by the distribution of solar energy on the inside surfaces of the zone, the user should give the command:

SOLAR DISTRIBUTION = 1;

BLAST will then calculate the amount of beam radiation falling on each surface in the zone by projecting the sun's rays through the windows. It is up to the user to ensure that the surfaces of the zone totally enclose a space.

When SOLAR DISTRIBUTION is not specified, shadow patterns on exterior surfaces caused by detached shading, wings, overhangs, and exterior surfaces of all zones are computed. Beam sunlight transmitted through windows is assumed to be incident on the floor, where it is absorbed according to the floor's solar absorptance. Any not absorbed is added to the transmitted diffuse radiation which is uniformly incident on all interior surfaces.

#### Scheduled Loads

(60, 62, 108, 114)

There are now 12 nongeometric factors which may be used to describe a zone. In addition, the capabilities of the seven factors in BLAST Version 2.0 have been increased. All 12 factors are optional.

#### PEOPLE

(5,12,19,60-61)

The number of persons occupying a zone are part of the zone load:

PEOPLE = usn1, schedule, AT ACTIVITY LEVEL usn2,  
usn3 PERCENT RADIANT, FROM date1 THRU date2;

The minimum specification for PEOPLE is the maximum number of people (usn1) expected to occupy the zone being described. The user should also select a schedule name from the schedule library; this schedule is the set of hourly profiles for each day of the week and special days being simulated for the zone. It is used to apportion the maximum PEOPLE value for each hour of the day. If no schedule is named, the zone will be assigned the maximum number of people for all hours of all days.

The user may also specify the activity level; i.e., the amount of heat given off per person per hour in kBtu/hr (kW). The default is 0.450 kBtu/hr (0.13 kW) or the value for light office work (a factory worker would generate about 1.6 kBtu/hr [0.47 kW]). The amount of heat given off by a person occupying a building zone is split into sensible and latent components based on room temperature. The user may also specify what percent of the sensible heat is radiant; if the percent is not specified, a radiant default value of 70 percent is used.

If the schedule applies to only part of a year, the start and stop dates may be specified. The default dates are FROM 01JAN THRU 31DEC. More PEOPLE statements may be given as long as the time periods do not overlap. Any period of a year not covered will have no people assigned to the zone.

#### LIGHTS

(5,60-61)

Lighting energy is considered part of the electric load of a zone:

LIGHTS = usn1, schedule, usn2 PERCENT RETURN AIR, usn3 PERCENT  
RADIANT, usn4 PERCENT VISIBLE, usn5 PERCENT REPLACEABLE,  
FROM date1 THRU date2;

The minimum specification for LIGHTS is the peak lighting level in kBtu/hr (or kW). If return air vents in the lighting fixture remove a portion of the heat from the room, this is specified as PERCENT RETURN AIR. Note that



part of the lighting energy is radiated as light (PERCENT VISIBLE) and part is radiated as heat (PERCENT RADIANT). The default values of these two parameters are both 20 percent and are appropriate for fluorescent lights. Incandescent lights are approximately 80 percent radiant and 10 percent visible. A distinction is made between the two forms of radiation by determining how much is absorbed in the zone surfaces according to the thermal and solar absorptances of the materials. Also, windows may transmit part of the visible energy out of the zone. In addition, the LIGHTS statement may be made to apply for part of the year, or the user may specify that the time periods for lights may overlap. (Specifying overlapping time periods for lights can be used to account for simultaneous fluorescent and incandescent lights or general and task lighting on different schedules.) The PERCENT REPLACEABLE refers to the percent of electric lighting which can be replaced by natural light (see DAYLIGHT).

#### ELECTRIC EQUIPMENT

(60-61)

Electric equipment also adds to the electric load of the zone:

ELECTRIC EQUIPMENT = usn1, schedule, usn2 PERCENT RADIANT, usn3 PERCENT LATENT, usn4 PERCENT LOST, FROM date1 THRU date2;

The minimum specification for ELECTRIC EQUIPMENT is the peak power in kBtu/hr (or kW). The default schedule gives constant hourly loads. PERCENT LATENT is the percentage of the equipment power which enters the zone as moisture; its default is 0. The default PERCENT RADIANT from equipment is 30 percent. If, for whatever reason, a portion of the equipment energy is not added to the zone, this is specified as a PERCENT LOST. Time periods may be specified; they may overlap.

#### GAS EQUIPMENT

(60-61)

Gas equipment is specified in the same way as electric equipment (gas equipment energy is part of the gas load of the zone):

GAS EQUIPMENT = usn1, schedule, usn2 PERCENT RADIANT, usn3 PERCENT LATENT, usn4 PERCENT LOST, FROM date1 THRU date 2;

#### OTHER

(Not in the BLAST Version 2.0 Users Manual)

The OTHER statement considers miscellaneous load in a zone; it is similar to the electric and gas equipment statements:

OTHER = usn1, schedule, usn2 PERCENT RADIANT, usn3 PERCENT LATENT, FROM date1 THRU date2;

The OTHER statement allows a load to be put on the zone without adding to the zone electric or gas load. It may be useful for describing loads which are not part of the building energy budget. A negative peak power could be used to describe equipment which has a cooling effect on the zone. The term PERCENT LOST has no meaning for this statement.

The user may also consider infiltration when specifying the load on a zone:

INFILTRATION = usn1, schedule, WITH COEFFICIENTS (A, B, C, D),  
FROM date1 THRU date2;

The minimum specification for INFILTRATION is the peak infiltration in cu ft/min (or m<sup>3</sup>/s). The default schedule is constant infiltration; the user may find that specifying a schedule can help describe peak hours for door openings. The optional coefficients vary the infiltration according to wind speed and temperature based on the following equation:

$$I_{act} = I_{max} * F_{sch} * (A + B * [T_{zone} - T_{odb}] + C * W_{spd} + D * W_{spd}^2) \quad [Eq 1]$$

where:  $I_{act}$  = the actual infiltration

$I_{max}$  = the maximum infiltration specified by the user

$F_{sch}$  = fractional infiltration from the user-specified library schedule

$T_{zone}$  = the inside temperature

$T_{odb}$  = the outside temperature

$W_{spd}$  = the windspeed

A = first user-specified coefficient; default value = 0.606

B = second user-specified coefficient; default value = 0.0202(1/°F)(0.036[1/°C])

C = third user-specified coefficient; default value = 0.000598 min/ft (0.1177 s/m)

D = fourth user-specified coefficient; default value = 0.0 min<sup>2</sup>/sq ft (0.0 s<sup>2</sup>/m<sup>2</sup>).

Users who wish to have a constant infiltration rate (subject to the schedule used for infiltration) should set A equal to 1 and the other coefficients equal to 0.

A recent comparison of loads computed by the BLAST and NBSLD programs indicate that users may not understand the meaning of the peak infiltration value in the "INFILTRATION = ..." expression.<sup>2</sup> In BLAST, this expression describes the amount of infiltration which occurs at 7.5 mph (3.3 m/s) wind speed and a 0°F (17°C) zone to ambient temperature difference, i.e., a typical

<sup>2</sup> National Bureau of Standards Load Determination Program, (National Bureau of Standards [NBS], 1979).

summer condition. The NBSLD program uses peak conditions of 15 mph and 70°F (6.7 m/s and 21°C) temperature difference, i.e., a winter design condition. Using the same number for peak value gives 2.8 times as much infiltration in BLAST as in NBSLD. Users who wish to base the peak infiltration on the NBSLD (winter design) conditions may use the following infiltration coefficients: (0.212, 0.00719, 0.000213, 0.0). The time periods of multiple infiltration statements may not overlap.

#### VENTILATION

(Not in the BLAST Version 2.0 Users Manual)

The VENTILATION statement allows the accurate calculation of the zone's response to one of two methods of ventilation cooling:

```
VENTILATION = usn1, schedule, usn2 MIN TEMP,  
              usn3 MAX TEMP, usn4 DEL TEMP, FROM date1 THRU date2;
```

The first method ventilates the zone whenever its temperature exceeds a given value and cooling can occur. The minimum specification is (1) the peak ventilation rate (usn1) in cu ft/min (or m<sup>3</sup>/s) and (2) the zone temperature MAX TEMP. The optional schedule permits hourly variation of the maximum ventilation rate; the DEL TEMP specification requires that the outside air temperature be usn4 °F (°C) cooler than the zone air before ventilation occurs. The user does not specify MIN TEMP.

The second method ventilates the zone down to some minimum temperature. The minimum specification is the peak ventilation rate and the desired zone temperature (MIN TEMP). The user does not specify MAX TEMP. The optional schedule and DEL TEMP are used as described above. When the user specifies a schedule, it is possible to do ventilation only between certain hours. The BLAST program does not allow the ventilation to lower the zone air temperature to a point that would require heating. Note that the time periods of multiple ventilation statements may not overlap.

#### MIXING

(Not in the BLAST Version 2.0 Users Manual)

The MIXING statement causes some amount of air to be supplied to the zone from some other zone:

```
MIXING = usn1, schedule, FROM ZONE usn2, usn3 DEL TEMP,  
        FROM date1 THRU date2;
```

The minimum specification is the peak mixing (usn1) in cu ft/min (or m<sup>3</sup>/s) and the zone (usn2) from which air is being drawn. The default schedule is constant for all hours. When usn3 is positive, the temperature of the zone from which the air is being drawn must be usn3 °F (or °C) warmer than the zone air or else there is no mixing. When usn3 is negative, the temperature of the source zone must be usn4 less than the zone air.

The time periods of multiple mixing statements with the same source zone may not overlap. There may be mixing from several different source zones simultaneously.

Baseboard heating is also considered as part of the zone load:

BASEBOARD HEATING = (usn1 AT usn2, usn3 AT usn4), schedule,  
usn5 PERCENT RADIANT, FROM date1 THRU date2;

The minimum specification for outdoor temperature-controlled baseboard heating is the same as that described in the BLAST Version 2.0 Users Manual, i.e., the expression "(usn1 AT usn2, usn3 AT usn4)." The terms usn1 and usn3 are baseboard heating capacities at the temperatures given by the terms usn2 and usn4. The optional schedule allows both capacities to change hourly on a proportional basis. The default PERCENT RADIANT is 0. The time period for operation of baseboard heating must be specified by the start and stop dates; the defaults are FROM 01JAN THRU 31DEC. (In earlier versions of BLAST, the time period was determined by the heating start and stop dates of the room temperature control schedule.) Time periods of multiple statements may overlap.

#### CONTROLS

(62)

Control strategies are considered in the zone load by:

CONTROLS = schedule, usn1 HEATING, usn2 COOLING,  
usn3 PERCENT RADIANT, FROM date1 THRU date2;

The minimum specification for room temperature control is the schedule name from the control schedules library. The default heating and cooling capacities are 3412 MBtu/hr (1000 MW). These large default capacities are helpful when a building is being run for the first time on BLAST; i.e., before the user knows what capacities should be used. This first run will indicate the peak heating and cooling required to maintain the room at a temperature very close to the desired set point; a check of BLAST's output will permit a determination of the required capacity. Once the required capacity is known, it can be used by BLAST in its annual calculations or in subsequent design day runs. The PERCENT RADIANT term is the percent of the zone mean radiant temperature used to determine the effective temperature necessary to compute the zone load.

Eq 2 allows an approximation of the comfort effect of radiant temperature on the zone load:

$$ET = \frac{usn3}{100} * MRT + \frac{1-usn3}{100} * MAT \quad [Eq 2]$$

where: ET = effective temperature  
MRT = mean radiant temperature  
MAT = mean air temperature.

The usn3's default is 0. According to Wray, usn3 = 0.45 is a good wintertime comfort index.<sup>3</sup> Summer conditions are complicated by the effect of humidity. BLAST does not compute the moisture balance in the building loads section. If the heating or cooling capacity is off for part of the year, that fact must be expressed by the start and stop dates. (Note that time periods may not overlap.) The BLAST program is slightly more efficient with a control profile that does not include heating (or cooling) than with one that has both and one capacity set to zero. If both heating and cooling capacities should be zero, as is common in attics, the user should not use any control statement.

#### DAYLIGHT

(Not in the BLAST Version 2.0 Users Manual)

The DAYLIGHT statement allows sunlight to be used to reduce the electric energy used for lights:

DAYLIGHT = schedule name, usn1 PERCENT BEAM USABLE,  
usn2 PERCENT DIFFUSE USABLE, FROM date1 THRU date2.

The term usn1 is the percent of beam solar radiation entering the room which can reduce electric lighting. The term usn2 is the percent of diffuse solar radiation (from the sky and reflected from the ground) entering the room which can reduce electric lighting. The schedule acts as a multiplier on usn1 to account for hourly variations as the sunlight patterns move across the room. The electric lighting energy will be reduced by the amount of usable beam plus the amount of usable diffuse radiation entering the zone up to the amount "replaceable" (see LIGHTS). The time periods of multiple daylight statements may not overlap.

#### INTERNAL MASS

(60,62,108,114)

The statement INTERNAL MASS allows the user to describe how internal partitions and zone contents absorb radiation and convert it to the zone air:

INTERNAL MASS: wall name (usn1 BY usn2);

It is a common practice to model zones by defining only the envelope surfaces and ignoring internal partitions and the zone contents. This often produces anomalous results because of the effects of radiant interchange. The statement INTERNAL MASS allows the user to overcome this problem. The description for INTERNAL MASS is the same as the minimum description of a partition described in the BLAST Version 2.0 Users Manual. The wall type should be selected to represent the average conductive properties of the internal partitions and zone contents. The expression "(width BY height)" should be selected to give an area equal to the total surface area exposed to the zone (e.g., both sides of internal partitions). When significantly different materials are present, it may be necessary to use more than one INTERNAL MASS statement.

<sup>3</sup> W. O. Wray, A Simple Procedure for Assessing Thermal Comfort in Passive Solar Heated Buildings, Report LA-CIR-80-550 (Los Alamos Scientific Laboratory, 1980).

## Mirror Image Zones

(50-60)

It is quite common for similar zones to be identical except that they are mirror images of each other. For example, zones 1 and 3 in Figure 22 of the BLAST Version 2.0 Users Manual are mirror images of each other. Most mirror image zones cannot be made from each other by any combination of rotations and translations. Therefore, two imaging commands have been added to let the user better describe similar zones:

```
MIRROR X;  
MIRROR Y;
```

The MIRROR X command causes the X-coordinates of all surfaces of the zone to be replaced by -X. The MIRROR Y command operates on the Y-coordinates. As with rotation, these commands do not move the origin of the zone. Thus, the simple four zone building in Figure 22 of the BLAST Version 2.0 Users Manual can be described as follows:

```
BEGIN BUILDING DESCRIPTION;  
DIMENSIONS; N=0, E=90, S=180, W=270;  
ZONE 1 "NORTHWEST OFFICE":  
  ORIGIN: (0, 16, 0);  
EXTERIOR WALLS:  
.  
.
```

full description of zone 1

```
.  
.  
END ZONE;  
ZONE 2 "NORTHEAST OFFICE":  
  ORIGIN: (40, 16, 0);  
  SAME AS ZONE 1 EXCEPT:  
    MIRROR X;  
END ZONE;  
ZONE 3 "SOUTHWEST OFFICE":  
  ORIGIN: (20, 0, 0);  
  SAME AS ZONE 1 EXCEPT:  
    MIRROR Y;  
END ZONE;  
ZONE 4 "SOUTHEAST OFFICE":  
  ORIGIN: (40, 12, 0);  
  SAME AS ZONE 1 EXCEPT:  
    MIRROR X;  
    MIRROR Y;  
END ZONE;  
END BUILDING DESCRIPTION
```

## Detached Shading

(71-72,76-77)

The syntax for describing detached shading has been expanded as follows:

```
DETACHED SHADING "usname" (usn1 BY usn2)
STARTING AT (usn3, usn4, usn5)
FACING (usn6) TILTED (usn7)
TRANS (usn8) FROM date1 THRU date2;
```

The term usn8 is the fractional transmittance (from 0.0 to 1.0) of the shading surface. The default value is 0.0, which is opaque. The transmittance and the optional dates allow the description of seasonal shading features such as trees. Dates should be chosen from the list given with overhangs and wings.

## Diffuse Solar Radiation Gains (Not in the BLAST Version 2.0 Users Manual)

The amount of diffuse solar radiation incident on building surfaces depends on the intensity of radiation and on the view factor between the surface and the radiation source. BLAST sets default view factors according to the tilt of the surface. The default view factor to the sky is

$$F_{s-s} (1 + \cos [\text{tilt}])/2 \quad [\text{Eq 3}]$$

The view factor to the ground is

$$F_{s-g} (1 - \cos [\text{tilt}])/2 \quad [\text{Eq 4}]$$

BLAST 3.0 allows the user to override these defaults by the statements VIEW TO SKY (usn) and VIEW TO GROUND (usn). When these statements appear before the description of subsurfaces, they apply to the base surface and all subsurfaces. When they appear after a subsurface, they apply only to that subsurface (and override any base surface values).

## Movable Insulation (Not in the BLAST Version 2.0 Users Manual)

Movable insulation can be added to the outside of surfaces which are exposed to the sun:

```
OUTSIDE INSULATION OF TYPE material name (passive control, FROM
date1a THRU date1b; ...; passive control5, FROM date5a THRU
date5b)
```

The material name refers to an element in the materials library. The R-value, absorptance, solar absorptance, and roughness of that material are used in evaluating the effects of movable insulation. (Note: this material shall be defined using the "R =" specification rather than the "L=", "K=", "D=", "CP=" specification in the BLAST library.) Up to five sets of passive control (from the passive control library) and time period are allowed. A minimum of one set is required. Time periods may not overlap. Dates should be chosen from the list with overhangs. There are no defaults for the parameters and the

passive controls must have been defined as SUNUP, SUNDOWN, or by a 24-hour profile.

If the insulation statement is placed before the description of any sub-surfaces (windows or doors), it applies to the base surface (exterior wall, roof, or exposed floor) and all subsurfaces. If the insulation statement is placed after a subsurface description, the movable insulation applies to the subsurface only.

### Solar Wall Input Language

The simulation of Trombe walls and water walls is handled by creating a special zone consisting of the wall, air channel, and cover. The syntax is best illustrated by referring to the following example:

```
.
.
.
25 TEMPORARY PASSIVE CONTROLS:
26 ALLON = (00 TO 24-ON);
27 CLOSED = (00 TO 24-OFF);
28 SUNUP = (SUNUP);
29 SUNDN = (SUNDOWN);
30 LOSS = (MAX LOSS);
31 GAIN = (MAX GAIN);
32 MT72 = (MAINTAIN 72);
33 VT70 = (VENT 70);
34 END;
.
.
.
47 ZONE 1 "TROMBE WALL":
48 ORIGIN:(0,0,0);
49 NORTH AXIS = 0;
50 SOLAR WALL:
51 STARTING AT (0,0,0) FACING (180)
52 TROMBE WALL - OUT (WIDTH1 BY HEIGHT1)
53 ADJACENT TO ZONE (2)
54 CHANNEL COEFFICIENTS (.5,-.5;VT70, FROM 1OCT THRU 3OAPR;
55   CLOSED, FROM 1MAY THRU 3OSEP)
56 COVER OF TYPE SINGLE PANE LW WINDOW (ALLON, FROM 1JAN THRU 31DEC)
57 OUTSIDE INSULATION OF TYPE R9 (SUNDN, FROM 1OCT THRU 3OAPR;
58   ALLON, FROM 1MAY THRU 3OSEP)
59 VIEW TO SKY (.45)
60 VIEW TO GROUND (.50)
61 WITH OVERHANG (WIDTH1 BY 0.5) AT (0,HEIGHT1);
62 END ZONE;
63 ZONE 2 "LEFT END UNIT":
64 ORIGIN:(0,0,0);
65 NORTH AXIS = 0;
66 INTERZONE PARTITION:
67 STARTING AT (0,0,0) FACING (180)
68 TROMBE WALL - IN (WIDTH1 BY HEIGHT1)
```



```

69  ADJACENT TO ZONE (1)
70  INSIDE INSULATION OF TYPE R9 (M1/2, FROM 1 OCT THRU 30 APR;
71  LOSS, FROM 1 MAY THRU 30 SEP);
72  EXTERIOR WALLS:

```

Lines 25 through 34 define various passive controls used in describing the solar wall. The special solar zone begins at line 47 and ends at line 61 with standard zone statements. The primary zone begins at line 63. Zone origin and facing angle (lines 48 and 49) may be given. The rest of the solar zone description occurs as part of a single wall description (beginning at line 50). Lines 51 and 52 show that the wall origin, azimuth, construction, and dimensions are the same as those given for simple exterior walls. A tilt angle may not be given. The wall must be vertical because of the algorithms used in computing its performance. The facing angle is relative to the primary zone, rather than the solar zone. The solar wall must be a rectangle. The geometric factors of lines 51 and 52 are the same as lines 67 and 68. Lines 52 and 68 use different constructs because of the normal change in point of view. The solar wall construct does not include the cover or the air layer. It includes only the mass between the air channel and the primary zone. The construct is taken from the walls library. The relationship between the solar zone and the primary zone is given in lines 53 and 69. The air channel is described in lines 54 and 55. The first number is the separation of the channel from the wall. The second number can have two meanings: if it is positive, it is the flow rate through the channel produced by a fan; if it is negative, it is the vent restriction for natural circulation as a fraction of the natural flow with no vent restriction. This is followed by one to five passive control descriptions separated by semicolons. Each passive control consists of a reference to a passive control in the library and a start and an end date. The type of control must be one appropriate to air channels. The description of the cover in line 56 includes a construct from the windows library and a single passive control in parentheses. The passive control is actually not used by the program, but is required because of syntax restrictions. Information in lines 50 through 56 is required for every solar wall. Typical outside insulation is described in lines 57 and 58. Sky and ground view factors may be given (lines 59 and 60). Wings and overhangs are optional. No other features may be described with a solar wall. Inside movable insulation with appropriate passive controls may be described as part of the interzone partition in the primary zone (lines 70 and 71). Each primary zone should be associated with no more than one solar zone.

#### Building Loads Report -- Default

(Chapter 4)

The calculation of zone loads for a group of zones produces four types of reports by default:

1. A report of all temperature control profiles used by the group of zones. This report includes an index number, a list of control points, and a graphic description of each control profile (Figure 2).

2. A report of general schedule profiles used by the group of zones. This report includes an index number, a list of hourly capacity percents, and a graphic display of capacity fractions for each schedule profile. A profile with no capacity greater than 5 percent will not be reported (Figure 3).

3. A description of zone report for each zone in the group. This report includes a list of the surfaces of the zone, a description of all scheduled loads, and all temperature control strategies. The surface U-value in BLAST Version 3.0 includes inside and outside film coefficients, as appropriate. The descriptions of schedules and controls refer to the index numbers of the temperature control profile and general schedule profile reports (Figure 4).

4. A summary of zone group loads report. This report includes names, total heating and cooling requirements, peak heating and cooling loads, and maximum and minimum temperatures for each zone. In addition, those quantities are summarized for the group of zones (Figure 5).

#### Building Loads Reports -- Optional

(76-82)

The WALLS, ZONE, and SHADE reports are as described in the BLAST Version 2.0 Users Manual, but the CONTINUOUS report has been deleted from BLAST Version 3.0. Users should now use the BLAST Report Writer to generate the information formerly found in the CONTINUOUS report. BLAST Version 3.0 also offers a new optional report name -- ZONE LOADS. ZONE LOADS will produce a loads summary report for each zone; this report was produced by default in earlier versions of the BLAST program (Figure 6).

CERL -- BLAST VERSION 3.0 PRELIMINARY 8 JUL 80 12.15.45.

TEMPERATURE CONTROL PROFILES:

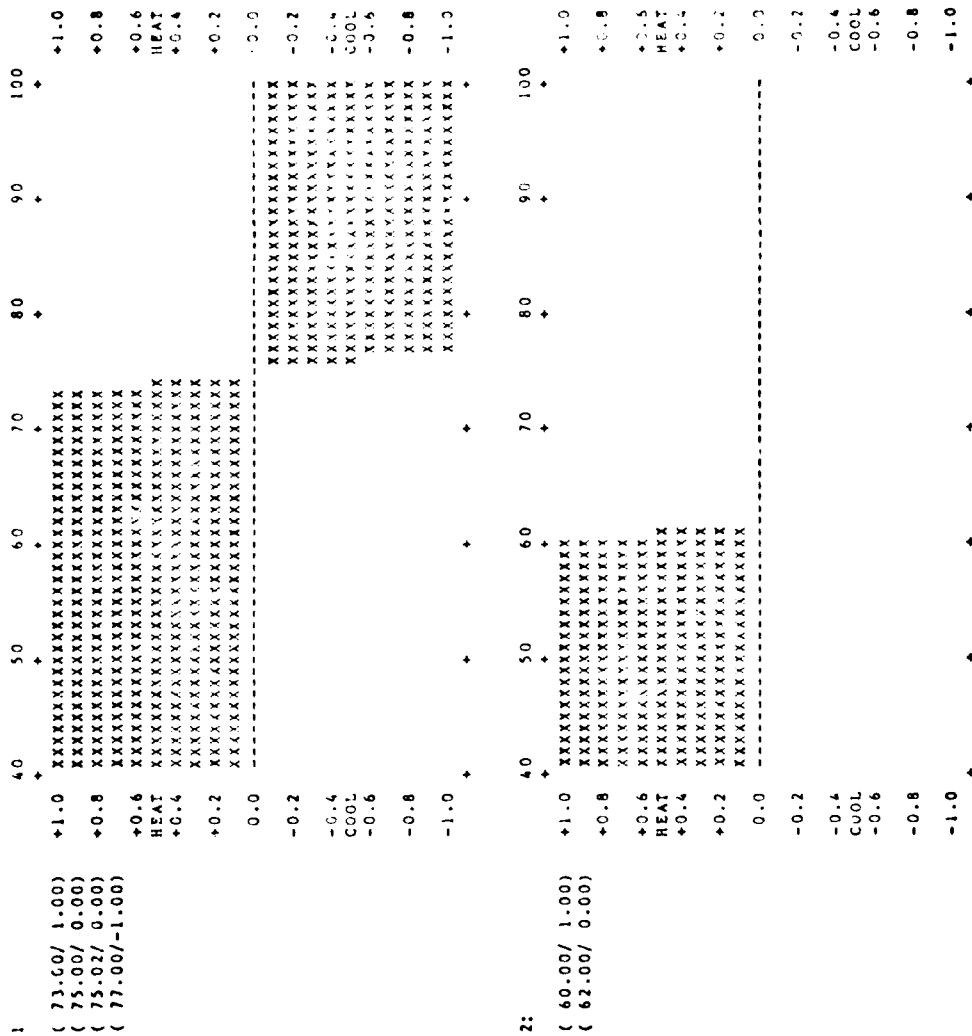


Figure 2. Temperature control profiles report.

CERL -- BLAST VERSION 3.0 PRELIMINARY 8 JUL 80 12-15-45.

GENERAL SCHEDULE PROFILES:

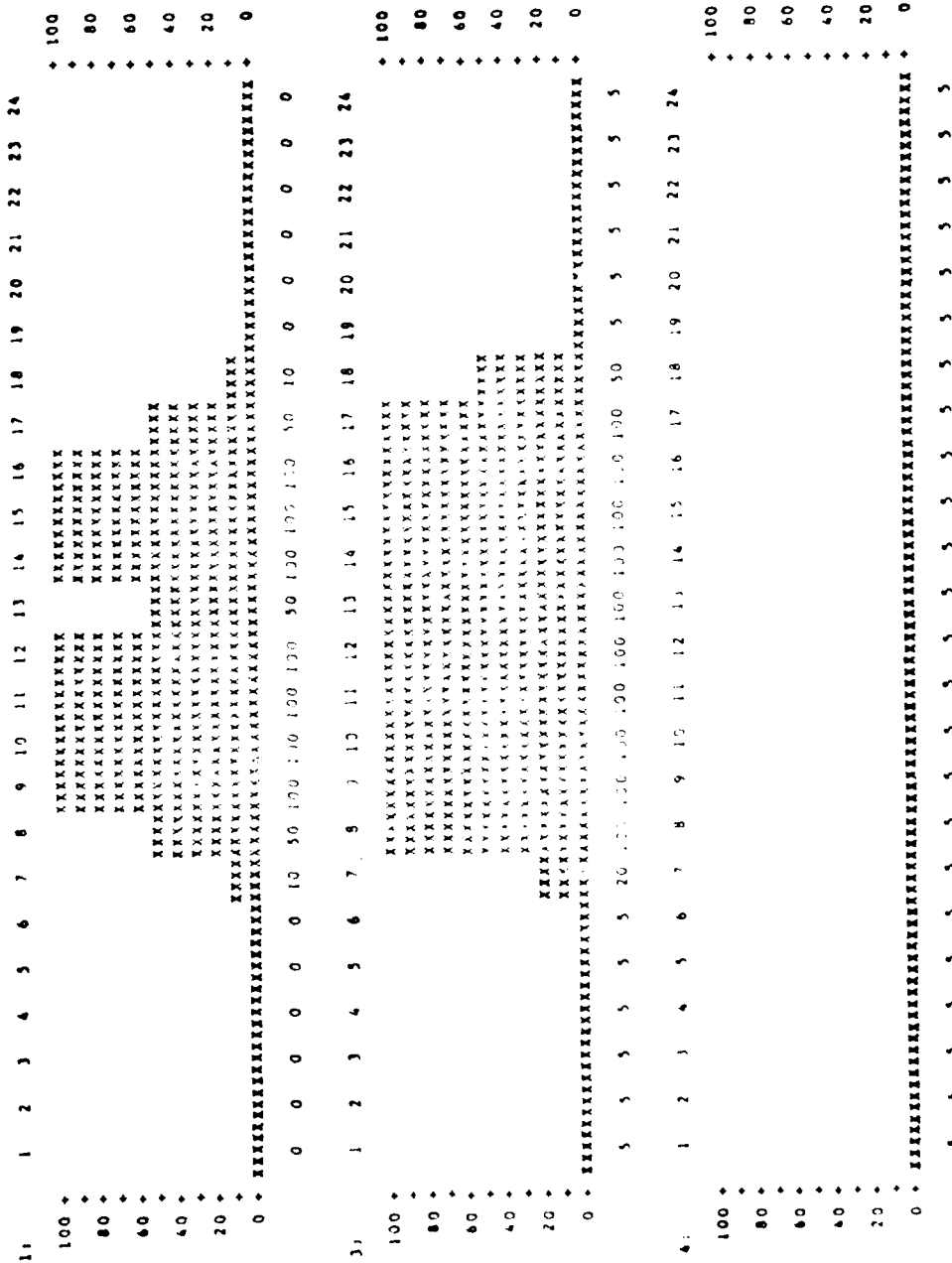


Figure 3. General schedule profiles report.



12.15.45.

8 JUL 80

PRELIMINARY

1968

TRY

NO

NO

NO

NO

NO

NO

NO

NO

NO

NO

MULTIPLIER

1  
1  
1  
1

MIN  
TEMP  
(F)

MAX  
TEMP  
(F)

PEAK  
COOLING  
(BTU/H)

PIAK  
HEATING  
(BTU/H)

PIAK  
HEATING  
(BTU/H)

PIAK  
HEATING  
(BTU/H)

PIAK  
HEATING  
(BTU/H)

PIAK  
HEATING  
(BTU/H)

PIAK  
HEATING  
(BTU/H)

PIAK  
HEATING  
(BTU/H)

PIAK  
HEATING  
(BTU/H)

Figure 1. Summary of zone group loads report.



## 5 FAN SYSTEM DESCRIPTION

The changes to the fan system description in BLAST Version 3.0 are the result of added simulation and scheduling options. New simulations include two new systems: two- and four-pipe induction units. Revised simulations include the DX packaged unit (water-cooled and evaporatively cooled condensers are now allowed) and the air-to-air heat recovery simulation (latent recovery is now allowed). BLAST's equipment scheduling options and report capability have been expanded to increase program flexibility; these improvements required that changes be made to the system identifier section and five of the six allowable fan system input blocks.

### System Identifier

(6,85,90-94,177-178,188-190)

Allowable system types now include:

TWO PIPE INDUCTION  
FOUR PIPE INDUCTION

The system diagrams of these new types are shown in Figures 7 and 8.

### Zone Data Block

The following input statement has been added:

RECOOL CAPACITY = usn (0.0 is default)

The RECOOL CAPACITY input specifies the design capacity of the recooling coils. Currently, recooling coils are allowed only for induction into systems and are assumed to be chilled water coils which accomplished sensible cooling only.

### Other System Parameters

(86-90)

The specification of outside air schedules has been moved to the EQUIPMENT SCHEDULES block in BLAST Version 3.0. Thus, the following inputs have been deleted from the BLAST Version 3.0's OTHER SYSTEM PARAMETERS data block:

WEEKDAY MINIMUM OUTSIDE AIR SCHEDULE = ...  
WEEKEND MINIMUM OUTSIDE AIR SCHEDULE = ...  
WEEKDAY MAXIMUM OUTSIDE AIR SCHEDULE = ...  
WEEKEND MAXIMUM OUTSIDE AIR SCHEDULE = ...

The following input statement has been added:

SYSTEM ELECTRICAL DEMAND = usn; (0.0 is default)

The SYSTEM ELECTRICAL DEMAND input along with the SYSTEM ELECTRICAL DEMAND SCHEDULE input from the EQUIPMENT SCHEDULE input block are used to account for miscellaneous system electrical demands such as controls, compressors, etc.



Table 1 lists the fan system types and indicates which of the other system parameters are relevant to the simulation of each system type.

#### Air-to-Heat Recovery Parameters

(6,84,93)

The HEAT RECOVER PARAMETERS input block has been expanded to include:

HTREC4 (0.0, 0.0, 0.0);  
HTREC5 (0.0, 0.0, 0.0);  
HTREC6 (0.0, 0.0, 0.0);

The HTREC1, HTREC2, and HTREC3 coefficients are used to determine the sensible heat recovery effectiveness; the HTREC4, HTREC5, and HTREC6 coefficients are used to determine the latent heat recovery effectiveness (see Eqs 5 and 6 below).

#### Sensible Heat Recovery

$$\begin{aligned} \text{Effectiveness} = & \text{HTREC1}(1) + \text{HTREC1}(2) * \text{MAXFLOW} + \text{HTREC1}(3) \\ & * \text{MAXFLOW}^2 + \text{HTREC2}(1) * \text{RATFLOW} + \text{HTREC2}(2) \\ & * \text{MAXFLOW} * \text{RATFLOW} + \text{HTREC2}(3) * \text{MAXFLOW}^2 \\ & * \text{RATFLOW} + \text{HTREC3}(1) * \text{RATFLOW}^2 + \text{HTREC3}(2) \\ & * \text{MAXFLOW} * \text{RATFLOW}^2 + \text{HTREC3}(3) * \text{MAXFLOW}^2 \\ & * \text{RATFLOW}^2 \end{aligned}$$

[Eq 5]

#### Latent Heat Recovery

$$\begin{aligned} \text{Effectiveness} = & \text{HTREC4}(1) + \text{HTREC4}(2) * \text{MAXFLOW} + \text{HTREC4}(3) \\ & * \text{MAXFLOW}^2 + \text{HTREC5}(1) * \text{RATFLOW} + \text{HTREC5}(2) \\ & * \text{MAXFLOW} * \text{RATFLOW} + \text{HTREC5}(3) * \text{MAXFLOW}^2 \\ & * \text{RATFLOW} + \text{HTREC6}(1) * \text{RATFLOW}^2 + \text{HTREC6}(2) \\ & * \text{MAXFLOW} * \text{RATFLOW}^2 + \text{HTREC6}(3) * \text{MAXFLOW}^2 \\ & * \text{RATFLOW}^2 \end{aligned}$$

[Eq 6]

where: MAXFLOW = the larger of the relief air mass flows and outside air mass flows for the current hour

RATFLOW = MAXFLOW divided by the smaller of the relief air mass flows or outside air mass flows for the current hour.

#### Equipment Schedules

(7,84,94-95)

The EQUIPMENT SCHEDULES input data block has been completely revised to allow users greater flexibility. All the existing EQUIPMENT SCHEDULES input commands have been deleted. The general form of the new schedule input command is:

component name = sched name, FROM date1 THRU date2,  
                  usn1 MAXIMUM TEMPERATURE,  
                  usn2 MINIMUM TEMPERATURE;

where:

component name =	SYSTEM OPERATION	FANCOIL HEATING OPERATION
	EXHAUST FAN OPERATION	FANCOIL COOLING OPERATION
	PREHEAT COIL OPERATION	TSTAT BASEBOARD HEAT OPERATION
	HEATING COIL OPERATION	HEAT RECOVERY OPERATION
	COOLING COIL OPERATION	MINIMUM VENTILATION SCHEDULE
	HUMIDIFIER OPERATION	MAXIMUM VENTILATION SCHEDULE
	REHEAT COIL OPERATION	SYSTEM ELECTRICAL DEMAND SCHEDULE
	RECOOL COIL OPERATION	

sched name = any previously defined library schedule name  
date1 = first day this schedule applies (of form DDMMM, i.e., 02JAN)  
date2 = last day this schedule applies (of form DDMMM, i.e., 31DEC)  
usn1 = outdoor air dry-bulb temperature above which this schedule does not apply; i.e., equipment will be turned off  
usn2 = outdoor air dry-bulb temperature below which this schedule does not apply; i.e., equipment will be turned off.

Specification of equipment schedules is optional. If equipment schedules are not specified for a component for a given date, the following default operating schedules apply:

SYSTEM OPERATION = on continuously all hours of all days of the simulation

EXHAUST FAN OPERATION  
HEATING COIL OPERATION  
COOLING COIL OPERATION  
HUMIDIFIER OPERATION  
REHEAT COIL OPERATION = on each hour the system is operating  
RECOOL COIL OPERATION  
FANCOIL HEATING OPERATION  
FANCOIL COOLING OPERATION  
TSTAT BASEBOARD HEAT OPERATION

HEAT RECOVERY OPERATION = off all hours of all days of the simulation

MINIMUM VENTILATION SCHEDULE = .15 for each hour of weekdays;  
.05 for each hour of weekend  
holidays and special days

MAXIMUM VENTILATION SCHEDULE = 1.0 for every hour of every day  
SYSTEM ELECTRICAL DEMAND SCHEDULE = 1.0 for every hour of every day.

When equipment schedules are specified, up to 32 schedule entries are permitted. For example, 32 different SYSTEM OPERATION schedules could be input, or 10 SYSTEM OPERATION schedules, 10 EXHAUST FAN OPERATION schedules, and 12 HUMIDIFIER OPERATION schedules could be provided.

When equipment schedules are specified for a particular component, each part of the general input command form is optional. If parts are omitted, the defaults are:

```
sched name = CONSTANT
date1 = 01JAN
date2 = 31DEC
usn1 = 392°F (200°C)
usn2 = -328°F (-200°C)
```

For example, specifying

```
RECOOL COIL OPERATION = SCHED1;
```

is equivalent to specifying

```
RECOOL COIL OPERATION = SCHED1, FROM 01JAN THRU 31DEC,
392 MAXIMUM TEMPERATURE, -328 MINIMUM
TEMPERATURE;
```

Equipment schedule parameters determine when the air-handling system components will operate. If system operation is specified as constant, the fan will operate throughout the simulation. Otherwise, its operation will be determined by the system schedule and the zone loads; i.e., the system will be on throughout the scheduled "on" period and off during the scheduled "off" period. However, the system will run even during the "off" period if there is a zone demand during any one hour. This schedule should, therefore, correspond to the control schedule specified in the zone load calculation phase. The fan operating mode and schedule can greatly affect the amount of energy required to heat and cool outside air. The preheat, heating, and cooling capacity schedules indicate the daily and seasonal period when these coils are supplied with energy. For example, if chillers are shut off at night and on weekends, the user should specify a cooling coil schedule which turns off the cooling coil on nights and weekends. In this example, no cooling energy will be used at night or on weekends even if the fan runs continuously or comes on at night because a heating (or cooling) load occurs.

For TWO PIPE FAN COIL or TWO PIPE INDUCTION systems, the user must override the seasonal heating and cooling availability schedules with schedules that do not overlap. This is because two-pipe systems cannot simultaneously heat and cool.

#### DX Condensing Unit Parameters

(6,84-90-93,95,179-187)

The DX CONDENSING UNIT PARAMETERS input block has been expanded to include:

```
CONDENSING UNIT TYPE = AIR COOLED (default)
                      WATER COOLED
                      EVAP COOLED
```

BLAST Version 3.0 will print as many as five summary reports directly related to the results of an air-handling system simulation:

1. AIR HANDLING SYSTEM ENERGY USE SUMMARY lists the total and peak demand for building and fan system consumption of electricity, gas, steam, hot water, and chilled water. For design day simulations, this information is reported hourly and daily; for weather tape simulations, this information is reported monthly and annually. This report is automatically produced when a system is simulated. Figure 9 shows a sample of this report for a design day and Figure 10 shows an example for a weather period.

2. AIR HANDLING SYSTEM LOADS NOT MET SUMMARY lists the excess of demand over capacity (where all demand is met, a zero or "NO UNMET LOADS FOR THIS ZONE" is printed). Unmet zone loads are caused by (a) insufficient air flow, (b) a deck temperature specified too low or high to deliver air hot or cold enough to meet all loads, or (c) coils scheduled to be off when they should be energized. This report prints the total and peak unmet load and the number of hours of unmet load (hourly and daily) for design days; it also prints the same information (monthly and annually) for weather simulations. This report is automatically produced when a system is simulated. A sample of this report is shown in Figure 11.

3. AIR HANDLING SYSTEM COMPONENT LOADS SUMMARY is produced only if specifically requested under RUN CONTROL (COIL LOADS report). It lists energy consumption and use statistics for all coils, humidifiers, and baseboard heat (see Figure 12).

4. AIR HANDLING SYSTEM LOADS SUMMARY lists the total and peak heating and cooling demands placed on the system by the building and the actual total and peak heating and cooling provided by the system. This report also produces an "energy budget" for the system and the building it serves. This report is produced only if specified under RUN CONTROL (SYSTEM LOADS report). A sample is shown in Figure 13.

5. AIR HANDLING SYSTEM DESCRIPTION report, produced only if requested under RUN CONTROL (SYSTEM report), prints all input values for the fan system description including values specifically input by the user or supplied as defaults by the program. Users are cautioned that not all the variables printed in this report will apply to any particular fan system. A sample is shown in Figure 14.

### Other System Parameters Applicability

• INDICATES PARAMETER MAY AFFECT SYSTEM

MULTIZONE  
DUAL DUCT (2)  
DUAL DUCT VARIABLE VOLUME  
THREE DECK MULTIZONE  
VARIABLE VOLUME  
TERMINAL REHEAT (1)  
SUBZONE REHEAT (1)  
TWO PIPE FAN COIL (1)  
FOUR PIPE FAN COIL (1)  
SINGLE ZONE DRAW THRU  
DX PACKAGED UNIT  
UNIT VENTILATOR  
TWO PIPE INDUCTION UNIT  
FOUR PIPE INDUCTION UNIT

SUPPLY FAN PRESSURE & EFFICIENCY  
RETURN FAN PRESSURE & EFFICIENCY  
EXHAUST FAN PRESSURE & EFFICIENCY  
COLD DECK CONTROL/TEMPERATURE  
COLD DECK THROTTLING RANGE  
COLD DECK CONTROL SCHEDULE  
HEATING COIL ENERGY/CAPACITY  
HOT DECK CONTROL/TEMPERATURE  
HOT DECK THROTTLING RANGE  
HOT DECK CONTROL SCHEDULE  
MIXED AIR CONTROL  
DESIRED MIXED AIR TEMPERATURE  
OUTSIDE AIR VOLUME  
PREHEAT COIL LOCATION  
PREHEAT TEMPERATURE  
PREHEAT ENERGY/CAPACITY  
GAS BURNER EFFICIENCY  
VAV MINIMUM AIR FRACTION  
VAV VOLUME CONTROL  
FAN POWER COEFFICIENTS  
HUMIDIFIER TYPE  
HUMIDISTAT LOCATION  
HUMIDISTAT SET POINT  
SYSTEM ELECTRICAL DEMAND

A 20x20 grid of dots. The dots are arranged in a pattern that is mostly filled, with some missing dots creating a specific shape. The pattern is symmetric about the vertical center line. The dots are arranged in a way that suggests a specific shape or structure, possibly related to the 'Puzzle 1' mentioned in the text.

1. HOT DECK TEMPERATURE SETS UPPER LIMIT ON REHEAT OR HEATING COIL TEMP.  
2. DUAL DECK IS THE SAME AS MULTIZONE IN BLAST; MULTIZONE IS THE RECOGNIZED NAME.

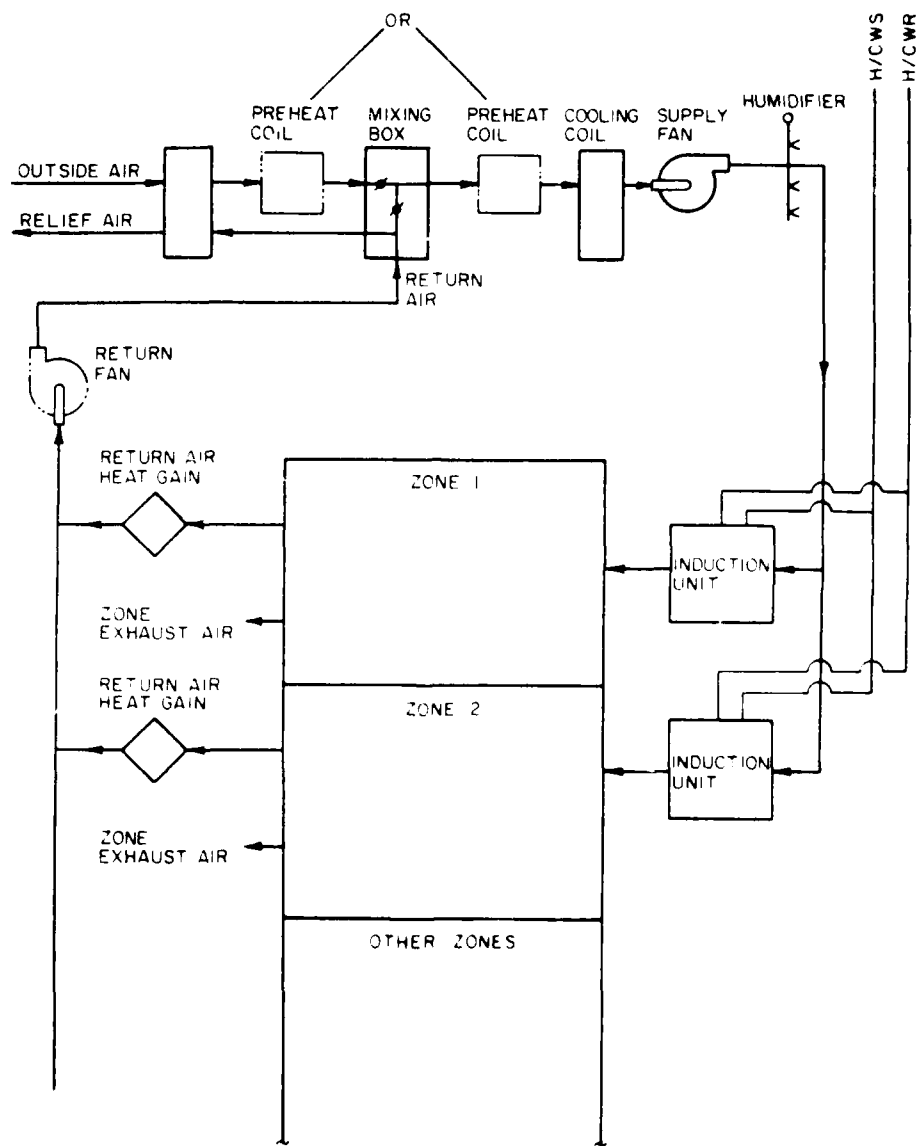


Figure 7. Two-pipe induction system.

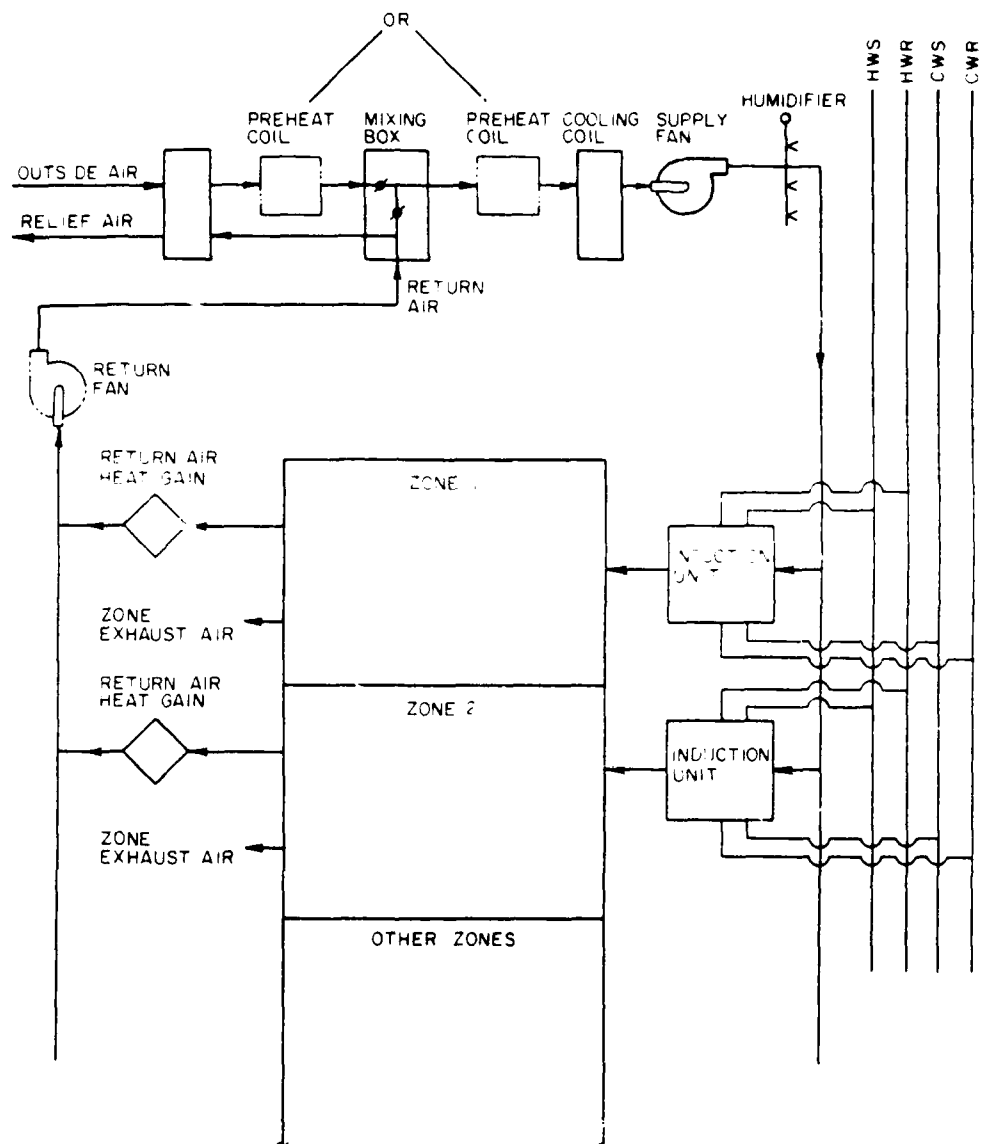


Figure 8. Four-pipe induction system.

SYSTEM NUMBER = 72		SYSTEM LOCATION = 0		SIMULATION PERIOD = 1/21/1980 - 1/21/1980				
E L E C T R I C I T Y								
HOURLY	BUILDING CONSUMPTION (BTU)	LIGHTS PEAK DEMAND (BTU/HR)	CONSUMPTION (BTU)	FANS PEAK DEMAND (BTU/HR)	HEATING CONSUMPTION (BTU)	PEAK DEMAND (BTU/HR)	TOTAL CONSUMPTION (BTU)	USE PEAK DEMAND (BTU/HR)
1	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
2	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
3	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
4	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
5	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
6	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
7	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
8	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
9	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
10	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
11	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
12	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
13	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
14	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
15	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
16	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
17	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
18	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
19	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
20	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
21	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
22	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
23	3.400E+02	3.400E+02	2.855E+03	2.855E+03	0.	0.	3.140E+03	3.140E+03
TOT	8.160E+03	3.400E+02	6.851E+04	2.855E+03	0.	0.	7.667E+04	3.195E+03

Figure 9. AIR HANDLING SYSTEM ENERGY USE SUMMARY (design day).



CERL -- BLAST VERSION 3.0 PRELIMINARY										6 MAY 80		17.46.33.		PAGE 45	
HOUR	G A S		S T E A M		H O T W A T E R		C H I L L E D W A T E R		TOTAL USE PEAK DEMAND (BTU/HR)	TOTAL USE PEAK DEMAND (BTU/HR)					
	CONSUMPTION (BTU)	TOTAL USE PEAK DEMAND (BTU/HR)	CONSUMPTION (BTU)	TOTAL USE PEAK DEMAND (BTU/HR)	CONSUMPTION (BTU)	TOTAL USE PEAK DEMAND (BTU/HR)	CONSUMPTION (BTU)	TOTAL USE PEAK DEMAND (BTU/HR)							
1	0.	0.	0.	0.	4.407E+04	4.407E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04					
2	0.	0.	0.	0.	4.41E+04	4.41E+04	1.61E+04	1.61E+04	1.61E+04	1.61E+04					
3	0.	0.	0.	0.	4.423E+04	4.423E+04	1.65E+04	1.65E+04	1.65E+04	1.65E+04					
4	0.	0.	0.	0.	4.433E+04	4.433E+04	1.65E+04	1.65E+04	1.65E+04	1.65E+04					
5	0.	0.	0.	0.	4.463E+04	4.463E+04	1.63E+04	1.63E+04	1.63E+04	1.63E+04					
6	0.	0.	0.	0.	4.463E+04	4.463E+04	1.63E+04	1.63E+04	1.63E+04	1.63E+04					
7	0.	0.	0.	0.	4.461E+04	4.461E+04	1.64E+04	1.64E+04	1.64E+04	1.64E+04					
8	0.	0.	0.	0.	4.491E+04	4.491E+04	1.63E+04	1.63E+04	1.63E+04	1.63E+04					
9	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
10	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
11	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
12	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
13	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
14	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
15	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
16	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
17	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
18	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
19	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
20	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
21	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
22	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
23	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
24	0.	0.	0.	0.	4.491E+04	4.491E+04	1.73E+04	1.73E+04	1.73E+04	1.73E+04					
TOT	0.	0.	0.	0.	9.777E+05	4.653E+04	4.270E+05	2.014E+04	2.014E+04	2.014E+04					

Figure 9. (Cont'd).

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AIR HANDLING SYSTEM ENERGY USE SUMMARY

SYSTEM NUMBER = 72		SYSTEM LOCATION = 13983		SIMULATION PERIOD = 1/ 1/1968 - 12/31/1968			
E L E C T R I C I T Y							
MONTH	BUILDING LIGHTS		FANS		HEATING		TOTAL USE
	CONSUMPTION (BTU)	PEAK DEMAND (BTU/HR)	CONSUMPTION (BTU)	PEAK DEMAND (BTU/HR)	CONSUMPTION (BTU)	PEAK DEMAND (BTU/HR)	
JAN	1.764E+06	6.800E+03	2.124E+06	2.855E+03	0.	0.	3.888E+06 9.55E+03
FEB	1.610E+06	6.800E+03	1.987E+06	2.855E+03	0.	0.	3.597E+06 9.65E+03
MAR	1.695E+06	6.800E+03	2.124E+06	2.855E+03	0.	0.	3.819E+06 9.67E+03
APR	1.756E+06	6.800E+03	2.055E+06	2.855E+03	0.	0.	3.811E+06 9.67E+03
MAY	1.764E+06	6.800E+03	2.124E+06	2.855E+03	0.	0.	3.888E+06 9.65E+03
JUN	1.618E+06	6.800E+03	2.055E+06	2.855E+03	0.	0.	3.674E+06 9.65E+03
JUL	1.764E+06	6.800E+03	2.124E+06	2.855E+03	0.	0.	3.888E+06 9.65E+03
AUG	1.764E+06	6.800E+03	2.124E+06	2.855E+03	0.	0.	3.888E+06 9.65E+03
SEP	1.618E+06	6.800E+03	2.055E+06	2.855E+03	0.	0.	3.819E+06 9.65E+03
OCT	1.695E+06	6.800E+03	2.124E+06	2.855E+03	0.	0.	3.811E+06 9.65E+03
NOV	1.618E+06	6.800E+03	2.055E+06	2.855E+03	0.	0.	3.674E+06 9.65E+03
DEC	1.695E+06	6.800E+03	2.124E+06	2.855E+03	0.	0.	3.811E+06 9.65E+03
TOT	2.036E+07	6.800E+03	2.507E+07	2.855E+03	0.	0.	4.544E+07 9.65E+03

Figure 10. AIR HANDLING SYSTEM ENERGY USE SUMMARY (weather period).

CERL -- BLAST VERSION 3.0 PRELIMINARY				6 MAY 80		17 APR 80	
MONTH	G A S		S T E A M		W A T E R		T O T A L
	CONSUMPTION (BTU)	PEAK DEMAND (BTU/HR)	CONSUMPTION (BTU)	PEAK DEMAND (BTU/HR)	CONSUMPTION (BTU)	PEAK DEMAND (BTU/HR)	
JAN	0.	0.	0.	0.	0.	0.	0.
FEB	0.	0.	0.	0.	0.	0.	0.
MAR	0.	0.	0.	0.	0.	0.	0.
APR	0.	0.	0.	0.	0.	0.	0.
MAY	0.	0.	0.	0.	0.	0.	0.
JUN	0.	0.	0.	0.	0.	0.	0.
JUL	0.	0.	0.	0.	0.	0.	0.
AUG	0.	0.	0.	0.	0.	0.	0.
SEP	0.	0.	0.	0.	0.	0.	0.
OCT	0.	0.	0.	0.	0.	0.	0.
NOV	0.	0.	0.	0.	0.	0.	0.
DEC	0.	0.	0.	0.	0.	0.	0.
TOT	0.	0.	0.	0.	0.	0.	0.

Figure 10. (Cont'd)

CERL -- BLAST VERSION 3.0 -- PRELIMINARY

```

.....
..
.. A T R H A N T N .....
..
.....

```

SYSTEM NUMBER

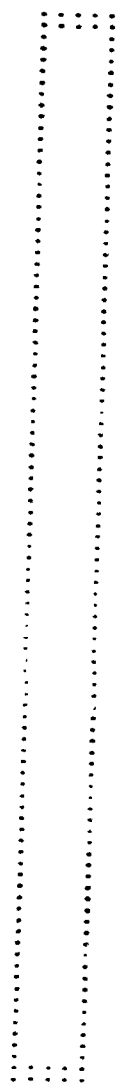
MONTH

ZONE

ZONE

ZONE

ZONE



1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the problem and the objectives of the research.

2. The second part of the report is a detailed description of the methods used in the study. It includes a discussion of the experimental design, the data collection procedures, and the statistical analysis techniques.

3. The third part of the report is a presentation of the results of the study. It includes a discussion of the findings and their implications for the field of research.

4. The fourth part of the report is a conclusion and a discussion of the limitations of the study. It also includes a list of references and a list of figures and tables.

Figure 1. A diagram showing the relationship between the variables in the study.

CERL -- BLAST VERSION 3.0 PRELIMINARY 5 MAY 80 17.46.33.

\*\*\*\*\*  
 AIR HANDLING SYSTEM LOAD SUMMARY  
 \*\*\*\*\*

MAIN  
 SYSTEM LOCATION = 3983 SYSTEM NUMBER = 72  
 SIMULATION PERIOD = 1/ 1/1968 - 12/31/1968

	TOTAL DEMAND (BTU)	PEAK DEMAND (BTU/HR)	TIME OF PEAK MO/DY/HR
SUM OF ZONE SENSIBLE HEATING LOADS	5.10773E+07	5.45365E+04	12/31/ 8
TOTAL HEATING PROVIDED BY SYSTEM	3.22087E+09	9.39606E+04	12/31/ 7
SUM OF ZONE SENSIBLE COOLING LOADS	1.18863E+07	2.21768E+04	8/23/15
SENSIBLE COOLING PROVIDED BY SYSTEM	2.68430E+08	4.98681E+04	7/21/16
LATENT COOLING PROVIDED BY SYSTEM	2.31314E+07	2.15880E+04	8/ 8/16
TOTAL COOLING PROVIDED BY SYSTEM	2.91622E+08	6.73214E+04	8/ 8/14

TOTAL ENERGY CONSUMED BY SYSTEM AND ZONES = 6.59145E+08  
 TOTAL FLOOR AREA SERVED BY FAN SYSTEM = 1.20000E+03 FT\*\*2  
 ENERGY BUDGET (TOTAL ENERGY/FLOOR AREA) = 5.49288E+05 BTU/FT\*\*2

NOTES: THIS ENERGY BUDGET DOES NOT INCLUDE ANY LOADS NOT MET OR ANY ENERGY FOR DOMESTIC HOT WATER. IT ALSO DOES NOT INCLUDE THE EFFECT OF THE PLANT ON ENERGY CONSUMPTION.

Figure 13. AIR HANDLING SYSTEM LOADS SUMMARY.

\*\*\*\*\*  
 AIR HANDLING SYSTEM DESCRIPTION  
 \*\*\*\*\*

MAIN

SYSTEM NUMBER = 72 SYSTEM LOCATION = 0  
 SIM. PERIOD = 21JAN1980 - 21JAN1980 NO. OF DAYS IN SIMULATION = 1  
 TYPE SYS = MULTIZONE NO. DISTINCT ZONES ON SYS. = 4

TOTAL SUPPLY FAN FLOW = 2.45914 IN-H2O  
 TOTAL EXHAUST FAN FLOW = 0.00000 IN-H2O  
 TOTAL EXHAUST FAN FLOW = 1.00000 IN-H2O

SUPPLY FAN EFFICIENCY = 0.70  
 EXHAUST FAN EFFICIENCY = 0.70  
 EXHAUST FAN EFFICIENCY = 0.70

MIXED AIR CONTROL = FIXED PERCENT  
 CONTROLLED MIXED AIR TEMPERATURE = 55.00 DEG. F

HOT FAN CONTROL = FIXED SET POINT  
 HOT FAN CONTROL SET POINT = 72.0000 DEG. F  
 HOT FAN FLOW TEMPERATURE = 40.0000 DEG. F

HEATING COIL CAPACITY = 13415.77 100GRTS HE  
 HEATING COIL EFFICIENCY = HOT WATER

COLD COIL CAPACITY = 13415.77 100GRTS HE  
 COLD COIL EFFICIENCY = HOT WATER  
 COLD DEC FLOW TEMPERATURE = 55.00 DEG. F

ZONE DATA SUMMARY

ZONE NUMBER	ZONE SUPPLY AIR VOL	ZONE EXHAUST AIR VOL	ZONE HEAT CAPCTY	ZONE HEAT CAPCTY	ZONE TSTAT BB CAPCTY	ZONE TSTAT BB CAPCTY	ZONE MULT
1	2.000E+02	0.	0.	0.	0.	0.	1.0
2	2.000E+02	0.	0.	0.	0.	0.	1.0
3	2.000E+02	0.	0.	0.	0.	0.	1.0
4	5.000E+02	0.	0.	0.	0.	0.	1.0

TOTAL DESIGN SUPPLY AIR VOLUME = 2.000E+03

Figure 14. AIR HANDLING SYSTEM DESCRIPTION.

## 6 PLANT DESCRIPTION

Changes in the central plant description in BLAST Version 3.0 are the result of added simulation and scheduling options. New simulations include free cooling, direct drive, and air cooled chillers, evaporative and well-water condensers, and direct cooling towers. Purchased steam has been added as a utility option and process waste heat can now be specified as a heat source for the plant. The equipment assignment and load scheduling options have also been expanded. These program improvements required changes to eight of 11 of BLAST's allowable central plant input blocks.

### Equipment Selection

(110-112)

The EQUIPMENT SELECTION input block has been completely revised to allow greater user flexibility. If equipment is specified in the plant, the EQUIPMENT SELECTION input block must appear as the first input block in the plant description.

The general syntax for EQUIPMENT SELECTION is:

EQUIPMENT SELECTION:

```
etypel WITH ctypel:
  usn1 of SIZE usn2 (usn3 AVAILABLE) WITH DRIVE OF SIZE usn4,
  :
  usn5 OF SIZE usn6 (usn7 AVAILABLE) WITH DRIVE OF SIZE usn8;
etype2 WITH ctype2:
  :
END EQUIPMENT SELECTION
```

where:

etype is the equipment type from Table 2

ctype is the condenser type for each chiller specified and is one of:

COOLING TOWER (default)

EVAPORATIVE CONDENSER

WELL WATER CONDENSER

usn1 is the number of pieces of equipment of etypel and size usn2 installed in plant.

usn3 is the number of units available (allows for standby units)

usn4 is the size of the drive unit for direct-drive chillers.

Up to six sizes of each equipment type may be specified; if different sizes are used they should be entered in ascending order. If the number available is omitted, it will default to the number installed. Only three chiller types and three generator types may be specified in one simulation.

Sizes are specified in 1000 Btu/hr (or kW) except for solar collectors, which are specified in square feet (or square meters), and hot and cold storage tanks, which are specified in 1000 Btu (or kWh).



An example EQUIPMENT SELECTION block for a plant containing two 100 kBtu/hr (32 kW) gas-fired boilers, a 150 and a 200 kBtu/hr (a 48 and a 64 kW) reciprocating chiller (both served by a well-water condenser), and a 100 kBtu/hr (32 kW) air-cooled chiller is shown below:

EQUIPMENT SELECTION:

BOILER:

2 of size 100;

RECIPROCATING CHILLER WITH WELL WATER CONDENSER:

1 of size 150,

1 of size 200,

AIR COOLED CHILLER:

1 of size 100,

END EQUIPMENT SELECTION;

Table 2 lists allowable names for equipment types. BOILER is a fuel-fired boiler and CHILLER is a hermetic centrifugal chiller; OPEN CHILLER is a nonhermetic (open) motor-driven centrifugal chiller.

Equipment Assignment

(7-8,112-120,136-137,140,191)

The user may specify operating rules for allocating each type and size of equipment to meet various heating, cooling, and electrical demands using the EQUIPMENT ASSIGNMENT input block. If not specified, default rules will assign equipment in a fashion designed to approach the best operating efficiency for the plant.

First, BLAST decides which equipment types should be operated. BLAST generally allocates the most efficient devices to meet demands. Thus, diesel generators (if specified in the plant) are allocated before steam turbines (if specified) which are allocated before gas turbines (if specified) to meet electrical demands. Likewise, fuel boilers (if specified) are allocated before electric boilers (if specified) to meet heating demands.

BLAST then determines the number of each size of the allocated equipment types that must be operated to approach the best operating point for that equipment type. The "best" operating point for each equipment type is specified using the PART LOAD RATIO's input block.

Users wishing to override all or some of the default operating rules in BLAST Version 3.0 should use the EQUIPMENT ASSIGNMENT input block. The BLAST Version 2.0 form of the EQUIPMENT ASSIGNMENT block is no longer valid and will not be processed if it is input to BLAST Version 3.0. The general form of the BLAST Version 3.0 EQUIPMENT ASSIGNMENT BLOCK is:

EQUIPMENT ASSIGNMENT:

COOLING:

```
FROM cdate1 THRU cdate2:
  FOR LOAD = usn1 USE cname 1 (a,b,c,d,e,f),
                      cname 2 (a,b,c,d,e,f),
                      cname 3 (a,b,c,d,e,f);
  :
  :
FROM cdate3 THRU cdate4:
  :
```

HEATING:

```
FROM hdate1 THRU hdate2:
  FOR LOAD = usn1 USE bname1 (a,b,c,d,e,f),
                      bname2 (a,b,c,d,e,f);
  :
  :
FROM hdate3 THRU hdate4:
  :
```

ELECTRIC:

```
FROM edate1 THRU edate2:
  FOR LOAD = usn1 USE gname1 (a,b,c,d,e,f),
                      gname2 (a,b,c,d,e,f),
                      gname3 (a,b,c,d,e,f);
  :
  :
FROM edate3 THRU edate4:
END EQUIPMENT ASSIGNMENT;
```

where:

cdate1, hdate1, and edate1 are of the form DDMMM, i.e., 15JAN, and are the starting date of the block definition

cdate2, hdate2, and edate2 are of the form DDMMM, i.e., 15 JAN, and are the ending date of the block definition

cname1-3, bname1-2, and gname1-3 are the names of the chillers, boilers, and generators specified in the EQUIPMENT SELECTION input block

usn1, usn2... are the upper limits of the load range

(a,b,c,d,e,f) specifies the number of units of each size which are allowed to operate for this load range.

```

      * size 100,
      * size 200,

      * size 1000,
      * size 2000,

      * size 1000,
      * size 2000,

END EQUIPMENT SELECTION;
EQUIPMENT ASSIGNMENT:
  COOLING:
    FROM 01SEP THRU 31MAR:
      FOR LOAD = 500 USE CHILLER (1,2),
      OPEN CHILLER (0,0);
    FROM 01MAY THRU 30AUG:
      FOR LOAD = 1000 USE CHILLER (0,0),
      OPEN CHILLER (1,0);
      FOR LOAD = 3000 USE CHILLER (0,0),
      OPEN CHILLER (1,1),
      FOR LOAD = 5000 USE CHILLER (0,0),
      OPEN CHILLER (1,2);
      FOR LOAD = 5500 USE CHILLER (1,2),
      OPEN CHILLER (1,2);

END EQUIPMENT ASSIGNMENT;

```

This input would assign equipment as follows:

1. For the period 1 September through 31 March, the open chillers would not operate regardless of the load. All three of the hermetic chillers would be operating to meet any cooling load.

2. For the period 1 May through 30 August, if the cooling load was 1000 kBtu/hr (318 kW) or less, one open chiller of size 1000 would be operating. If the load was between 1000 and 3000 kBtu/hr (318 and 955 kW), then one open chiller of size 1000 and one of size 2000 would be allowed to operate. If the load was between 3000 and 5000 kBtu/hr (955 and 1519 kW), then one open chiller of size 1000 and two open chillers of size 2000 would be operating. If the load was above 5000 kBtu/hr (1519 kW), then all the chillers specified in the equipment selection would be operating.

3. For the period 1 April through 30 April, the default equipment assignment strategy would be used.

#### Part-Load Ratios

(113-114,191)

The syntax for the PART LOAD RATIOS block is the same as that described in the BLAST Version 2.0 Users Manual. Input is now accepted only for the equipment types specified in the EQUIPMENT SELECTION block. The defaults for the new equipment types are in Table 3.

## Schedule

(114-115)

BLAST Version 3.0 expands the SCHEDULE input block to include specification of domestic hot water demand, plant electrical demand, and availability of process waste heat. The syntax for the hot water input is as follows:

```
HOT WATER = usn1, schedname, FROM date1 THRU date2 SUPPLIED BY
           esource;
```

where:

```
usn1 = peak demand for hot water in 1000 Btu/hr (or kW) (default = 0.0)
schedname = any previously defined schedule name from the library (def = CONSTANT)
date1 = start date for this load (of form DMMM, i.e., 15JAN) (def = 01JAN)
date2 = stop date for this load (of form DMMM, i.e., 15JAN) (def = 31DEC)
esource = BOILER or ELECTRIC BOILER (def = BOILER)
```

This command can be repeated up to 12 times.

The PLANT ELECTRICAL command is used to describe a demand for electricity in the plant which is not otherwise accounted for. The syntax is:

```
PLANT ELECTRICAL DEMAND = usn1, schedname, FROM date1 THRU date2;
```

where:

```
usn1 = peak demand for electricity in 1000 Btu/hr (or kW) (default = 0.0)
schedname = any previously defined schedule name from the library (def = CONSTANT)
date1 = start date for this load (of form DMMM, i.e., 15JAN) (def = 1JAN)
date2 = stop date for this load (of form DMMM, i.e., 15JAN) (def = 31DEC)
```

This command may be repeated up to 12 times.

The PROCESS WASTE HEAT command is used to describe the availability of waste heat for use in the plant. The syntax is:

```
PROCESS WASTE HEAT = usn1, schedname, FROM date1 THRU date2 AT
                   LEVEL usn2;
```

where:

```
usn1 = peak amount of waste heat available in 1000 Btu/hr (or kW) (default = 0.0)
schedname = any previously defined schedule name from the library (def = CONSTANT)
date1 = start date for this load (of form DMMM, i.e., 15JAN) (def = 1JAN)
date2 = stop date for this load (of form DMMM, i.e., 15JAN) (def = 31DEC)
usn2 = level number corresponding to the level of the waste energy available
      (see Appendix G of the BLAST Version 2.0 Users Manual) (def = 5).
```

An example SCHEDULE block is:

SCHEDULE:

```
    HOT WATER = 10, INTERMITTENT, FROM 01JAN THRU 31DEC;
    HOT WATER = 100, FROM 10JUN THRU 20JUN;
    PROCESS WASTE HEAT = 1000, CONSTANT, FROM 01JUN THRU 31JUL,
      AT LEVEL 3;
  END SCHEDULE;
```

The syntax for SPECIAL PARAMETERS is unchanged. The default values for SPECIAL PARAMETERS added to the input of BLAST Version 3.0 are shown in Table 4. Table 5 shows which special parameters are normally associated with a particular equipment type.

The meaning and effect of each added special parameter is described below. The defaults should be studied carefully, since they may be appropriate only for very conventional plants.

- EBEFF      Average efficiency of heat generation by the electric boiler.  
Efficiency equals heat output/electrical input.  
Units: dimensionless
- FCCTRL      Free cooling chiller control type. FCCTRL = 1 allows the chiller to work in the free cooling mode between the dates of FCON and FCOFF. FCCTRL = 2 allows the chiller to work in the free cooling mode if the outside air dry-bulb temperature is less than FCTEMP. FCCTRL = 3 allows the chiller to work in the free cooling mode if the outside air wet-bulb temperature is less than FCTEMP. FCCTRL = 4 allows the chiller to work in the free cooling mode if condenser water temperature entering the chiller is less than the desired leaving chilled water temperature.  
Units: dimensionless
- FCOFF      If FCCTRL = 1, the date the free cooling chiller switches from the free cooling mode to the regular mode. The date is computed from  $32 * \text{MONTH} + \text{DAY}$ . Thus FCOFF for 12 March is  $32 * 3 + 12 = 108$ .  
Units: dimensionless
- FCON      If FCCTRL = 1, the date the free cooling chiller switches from the regular mode to the free cooling chiller mode. The date is computed from  $32 * \text{MONTH} + \text{DAY}$ . Thus FCOFF for 12 March is  $32 * 10 + 18 = 338$ .  
Units: dimensionless
- FCTEMP      The free cooling chiller control temperature. If FCCTRL = 2, FCTEMP will be compared with the outside air dry-bulb temperature. If FCCTRL = 3, FCTEMP will be compared with the outside air wet-bulb temperature.  
Units: °F (°C)
- PELDTWR      The ratio of the direct cooling tower pump electrical energy required to cooling load on the direct cooling tower.  
Units: dimensionless
- PELECND      The ratio of the evaporative condenser pump electrical energy required to condenser load.  
Units: dimensionless
- PELWWC      The ratio of well-water condenser pump electrical energy required to condenser load.  
Units: dimensionless

RMXKWDC Maximum exhaust flow per unit capacity for diesel-driven chillers. The parameter sets an upper limit on exhaust gas flow and therefore exhaust gas heat recovery for diesel engines.  
Units: lb/hour per kBtu/hr of capacity (kg/s per kW of capacity)

RMXKWGC Same as RMXKWDC, but applies to gas turbine-driven chillers.

RWCDB Ratio of condenser water flow rate to double-bundle chiller capacity.  
Units: lb/hr per kBtu/hr of capacity (kg/s per kW capacity)

RWCDC Same as RWCDB, but applies to diesel-driven chillers.

RWCFC Same as RWCDB, but applies to free cooling chillers.

RWCGC Same as RWCDB, but applies to gas turbine-driven chillers.

RWCHC Same as RWCDB, but applies to hermetic compression chillers.

RWCHP Same as RWCDB, but applies to heat pumps.

RWCOC Same as RWCDB, but applies to open chillers.

RWCRC Same as RWCDB, but applies to reciprocating chillers.

RWC1A Same as RWCDB, but applies to one-stage absorption chillers.

RWC2A Same as RWCDB, but applies to two-stage absorption chillers.

RWC2AE Same as RWCDB, but applies to two-stage absorption chiller with economizer.

TDCTWR Minimum allowable temperature for water leaving the direct cooling tower.  
Units: °F (°C)

TEVAPC Same as TDCTWR but for evaporative condenser.

TWWC Same as TDCTWR but for well-water condenser.

BLAST Version 3.0 deletes the following inputs from SPECIAL PARAMETERS:

CPTYPE SR1A SR2A RWCC RWCA TWMAKE

If one of the above is input to BLAST Version 3.0, a warning message will be issued and the input will be ignored.

BLAST Version 3.0 adds several new equipment performance parameters to describe the performance of the new component models. (The EQUIPMENT PERFORMANCE PARAMETERS syntax was not changed.) The new parameters and their default values are shown in table G.

Table 7 indicates which EQUIPMENT PERFORMANCE PARAMETERS apply to each central plant component. The meaning of each new EQUIPMENT PERFORMANCE PARAMETER is discussed below.

Table G. Equipment Performance Parameters and Default Values

Parameters and Default Values (English units only)

```
EQUIPMENT PERFORMANCE PARAMETERS
ADJTEC (95, 1.19, 44);
RCAVFC (1.006, -0.19, 1.006);
ADJTEC (3.158, -3.81, 1.154);
PPWREC (1.229, -1.04045, 1.29445);
CAVFCM (0.0, 1.0212, 1.0);
PWRECM (0.0, 0.0, 1.0);
END;
```

The free cooling chiller is an open centrifugal chiller which may obtain cooling with the compressor shut off when the condenser water temperature drops low enough by operating only a small refrigerant pump as well as the chilled water and condenser pumps. Therefore, the free cooling chiller operates in either the regular open chiller mode or the free cooling mode. The actual mode of operation is determined by the SPECIAL PARAMETERS FCCTRL, FCEN, FCOFF, and FTEMP.

If the chiller is operating in the "regular" mode, the chiller performance is described by the EQUIPMENT PERFORMANCE PARAMETERS ADJTEC, RCAFEC, ADJTEC, and PPWREC. These parameters are defined and used analogously to those for the double handle chiller as described on pages 215 to 221 of the BLAST Version 3.0 Users Manual.

If the chiller is operating in the "free cooling" mode, the chiller performance is determined by the EQUIPMENT PERFORMANCE PARAMETERS CAVFCM and PWRECM. First, the available free cooling capacity is determined using the CAVFCM parameter set. Next, the actual amount of free cooling used is computed. Finally, the electrical power consumption for the chiller in the free cooling mode is determined.

The available free cooling capacity is determined by:

$$Q_{FC} = C_{FC} \cdot (T_{CHW} - T_{COW}) \quad [Eq. 5]$$

where:

$A_1$ ,  $A_2$ , and  $A_3$  are the parameters of the CAVFCM set

OCAP is the design free cooling chiller capacity operating for that hour

TCOOL is the SPECIAL PARAMETER describing the leaving chilled water temperature

TECW is the chiller temperature of the condenser water entering the chiller

AVLCAP is the actual capacity available.

The actual cooling (FCCOOL) is determined by:

FCCOOL = minimum of ECOOL and AVLCAP

where:

ECOOL is the actual cooling load for that hour

The electrical consumption for the free cooling chiller in the free cooling mode is computed by:

$$ELEC = B_1 + B_2 * PLR + B_3 * PLR^2$$

$B_1$ ,  $B_2$ , and  $B_3$  are the parameters of the PWFCM set

PLR = FCCOOL/AVLCAP

ELEC = electricity consumed

Parameters and Default Values (English Units Only)

EQUIPMENT PERFORMANCE PARAMETERS:

ADJTAC (95, 1.19, 44);

RCAVAC (1.006, -.019, .0022)

ADJEAC (3.158, -3.313, 1.154);

RPWRAC (.239, -.04045, .79545);

END;

The performance of the air-cooled chiller is determined by the parameters listed above. These parameters are defined and used analogously to those for the double-bundle chiller as described on pages 213 to 221 of the BLAST Version 2.0 Users Manual, except for ADJTAC. The ADJTAC parameter set defines the  $T$  used in Eq G29 of the BLAST Version 2.0 Users Manual as

$$T = (T_{air} - A_1)/A_2 - (T_{cw} - A_3) \quad [Eq 6]$$



where:

Tair = ambient air dry bulb temperature

Tcw = leaving chilled water temperature

A<sub>1</sub>, A<sub>2</sub>, and A<sub>3</sub> are the parameters of the ADJTAC set for the air-cooled chiller

Equipment Performance Parameters -- Air-Cooled Chiller

#### Parameters and Default Values (English Units Only)

##### EQUIPMENT PERFORMANCE PARAMETERS:

ADJTDC (95, 1.19, 44);  
RCAVDC (1.006, -.019, .00022);  
ADJEDC (3.158, -3.313, 1.154);  
RPWRDC (.239, -.04045, .79545);  
RELDC (.09755, .6318, -.4165);  
RJACDC (.3922, -.4367, .27796);  
RLUBDC (.0803, -.1371, .0803);  
REXDC (.3144, -.1353, .09726);  
TEXDC (1179.4, 60.0, 0.0);  
UACD (.0308, .90, 0.0);

END;

The diesel-driven chiller is an open centrifugal chiller driven directly by a diesel engine. The parameters ADJTDC, RCAVDC, ADJEDC, and RPWRDC are used to describe the performance of the open chiller compressor unit. They are defined analogously to those for the double-bundle chiller on pages 213-221 of the BLAST Version 2.0 Users Manual, except that the power computed is shaft power required, not electrical power required. The parameters RELDC, RJACDC, RLUBDC, REXDC, TEXDC, and UACD are used to describe the performance of the diesel engine and are defined analogously to those for the diesel engine generator on pages 196 to 200 of the BLAST Version 2.0 Users Manual, except that the output is shaft power, not electricity.

Equipment Performance Parameters -- Diesel-Driven Chiller

#### Parameters and Default Values (English Units Only)

##### EQUIPMENT PERFORMANCE PARAMETERS:

ADJTGC (95., 1.19, 44);  
RCAVGC (1.006, -.019, .00022);  
ADJEGC (3.158, -3.313, 1.154);  
RPWRGC (.239, -.04045, .79545);  
FUL1GC (9.41, -9.48, 4.32);  
FUL2GC (1.0044, -.0026, 0.0);  
TEX1GC (917., 308., 80.);  
TEX2GC (1.006, .0018, 0.0);  
FEXG (15.63, -.099, -.0002);  
ELUBG (.223, -4., .2286);  
UACG (.0618, 0.9, 0.0);

END;

The gas turbine-driven chiller is an open centrifugal chiller driven directly by a gas turbine. The parameters ADJIGC, RCAVGC, ADJEGC, and KPWKIB are used to describe the performance of the open chiller compressor unit. They are defined analogously to those for the double-bundle chiller on pages 213 to 221 of the BLAST Version 2.0 Users Manual, except that the power computed is shaft power required, not electrical power required. The remaining parameters listed above describe the performance of the gas turbine and are defined analogously to those for the gas turbine generator on pages 200 to 205 of the BLAST Version 2.0 Users Manual, except that the output is shaft power, not electrical power.

#### Energy Cost

(122-125)

The ENERGY COST input block has been modified to accept PURCHASED STEAM as a utility option. The default values for purchased steam energy cost are all zero. Thus, if a user wishes to use purchased steam as an energy source, he must specify the ENERGY COST block for PURCHASED STEAM. The options discussed in the BLAST Version 2.0 Users Manual for other utilities also apply to PURCHASED STEAM.

#### Reference Equipment Cost

(125-127)

The format of the REFERENCE EQUIPMENT COST input block has not changed. The default values for the new equipment types are shown in Table 8.

#### Reports

(Not in the BLAST Version 2.0 Users Manual)

A default PLANT LOADS NOT MET report has been added to BLAST Version 3.0. This report summarizes the heating, cooling, and electrical demands which were not met by the plant. Unmet plant loads result from undersized equipment or bad equipment scheduling. An example of this report is shown in Figure 15.

An additional optional report has been added to the plant simulation report capability. The report is obtained by specifying PLANT LOADS as a REPORTS parameter in RUN CONTROL. An example of this report is shown in Figure 16.



Table 3  
Default Part-Load Ratio

Equipment Type	Part-Load Ratios			Electrical Input to Nominal Capacity Ratio
	Minimum	Maximum	Optimum	
ELECTRIC BOILER	0.0	1.0	1.0	1.05
FREE COOLING CHILLER	0.10	1.05	0.65	0.2275
DIRECT COOLING TOWER	0.0	1.00	N/A	0.012
DIESEL DRIVEN CHILLER	0.10	1.05	0.65	0.25
GAS TURBINE DRIVEN CHILLER	0.02	1.05	0.60	0.25
AIR COOLED CHILLER	0.10	1.05	0.65	0.2275
EVAPORATIVE CONDENSER	0.0	1.0	N/A	0.012
WELL WATER CONDENSER	0.0	1.0	N/A	0.012

Table 4

## Additional Special Parameters Table

Special Parameter Name	Special Parameter Description	Default Value (English)
TDCTWR	Min leave direct cooling tower water temp	32.5
TEVAPC	Min leave evap cond water temp	60.0
TWWC	Min leave well water cond. water temp	32.5
PELECND	Elec input evap cond pump/evap cond design cap	0.012
PELWNC	Elec input well water cond pump/well water cond cap	0.012
FCCTRL	Free Cooling Chiller Control Type	1.0
FCOFF	Free Cooling Chiller Off Date	415.0
FCON	Free Cooling Chiller On Date	33.0
FCTEMP	Free Cooling Chiller Control Temp	50.
RWCHC	Tower Water/Hermetic Chiller Cap	124.8
RWCEC	Tower Water/Free Cooling Chiller Cap	124.8
RWRC	Tower Water/Reciprocating Chiller Cap	124.8
RWOC	Tower Water/Open Chiller Cap	124.8
RWCA	Tower Water/One Stage Absorber Cap	124.8
RWCA	Tower Water/Two Stage Absorber Cap	124.8
RWC2AL	Tower Water/Two Stage Absorber Cap	124.8
RWCD	Tower Water/Diesel Chiller Cap	124.8
RWGC	Tower Water/Gas Turbine Chiller Cap	124.8
RMXKWDC	Max Exh Flow/Power Output Diesel Chiller	1.46
PELDTWR	Elec Input Direct Tower Pump/Direct Tower Cap	0.12
EBEFF	Electric Boiler Efficiency	1.0
RMXKWGC	Max Exh Flow/Power Output Gas Turbine Chiller	11.71

Table 5  
Special Parameter Applicability

SPECIAL PARAMETER	EQUIP TYPE	AIR COOLED CHILLER	BOILER	CHILLER	COLD STORAGE TANK	COOLING TOWER	DIESEL DRIVEN CHILLER	DIRECT COOLING TOWER	DOUBLE BUNDLE CHILLER	ELECTRIC BOILER	EVAPORATIVE CONDENSER	FREE COOLING CHILLER	GAS TURBINE	GAS TURBINE DRIVEN CHILLER	HEAT PUMP	HOT STORAGE TANK	ONE STAGE ABSORBER	OPEN CHILLER	RECIPROCATING CHILLER	SOLAR COLLECTOR	STEAM TURBINE	TWO STAGE ABSORBER	TWO STAGE ABSORBER W/ECOM	WELL WATER CONDENSER	PUMPS
AZMUTH																									
EBEFF																									
FCCTRL																									
FCOFF																									
FCOM																									
FCTEMP																									
FLOWRT																									
HFUELB																									
HTXEFF																									
MXTNK7																									
PELCL																									
PELOTWR																									
PELECND																									
PELHT																									
PELTWR																									
PELWVC																									
PSTEAM																									
PSTMTUR																									
RAVRHDB																									
RAVRHHP																									
RFLASH																									
RHFLASH																									
RMXKWQ																									
RMXKWDC																									
RMXKWG																									
RMXKWGC																									
RPWNOH																									
RWCDB																									
RWCDC																									
RWCFC																									
RWCOC																									
RWCOC																									
RWCOC																									
RWCRC																									
RWC1A																									
RWC2A																									
RWC2AE																									
RWSTUR																									
SRATB																									
STEAM																									
TCOOL																									
TCW																									
TDCTWR																									
TEVAPC																									
TILT																									
TLEAVE																									
TMINC																									
TMINH																									
TMWHP																									
TNKCAP																									
TNKTEN																									
TOTUEF																									
TOWOPR																									
TSATUR																									
TSTMTUR																									
TTOWR																									
TWVC																									

Table 6

## New Equipment Performance Parameters and Defaults

C O D E	N A M E	EQUIPMENT PERFORMANCE COEFFS			DATA	C O E F F			VALUE(ENGLISH)
		C O E F F	1	C O E F F	2	C O E F F	3		
ECPU	COND PUMP POWER COEFF	1.00000000				0.00000000			0.00000000
WCPUMP	WELL WATER COND PUMP POWER COEFF	1.00000000				0.00000000			0.00000000
DTRUMP	DIRECT TOWER PUMP POWER COEFF	1.00000000				0.00000000			0.00000000
CAVFCM	FREE COOL CHLR CAPC ADJ FACTR	0.00000000				0.02777778			0.00000000
PWRFCH	FREE COOL CHLR POWER ADJ COEFF	0.00000000				0.00000000			0.00000000
ADJTFC	FREE COOL CHLR COND COOL WTR T ADJ	95.00000000				1.19000000			43.98800000
RCVAVFC	FREE COOL CHLR CAPC ADJ FACTR	1.00600000				-3.01900000			0.00220000
ADJTEFC	FREE COOL CHLR ENERGY RATIO ADJ	3.15800000				-3.31300000			0.15400000
RPWRFC	FREE COOL CHLR ENERGY I/O COEFF	.23900000				-.04045000			.79545000
ADJTDCC	DIRECT TOWER CAPC ADJ FACTR	95.00000000				1.19000000			43.98800000
RCVAVDC	DIRECT TOWER POWER ADJ COEFF	1.00600000				-0.01900000			0.00220000
ADJTEDC	DIRECT TOWER ENERGY RATIO ADJ	3.15800000				-3.31300000			1.15400000
RPWRDC	DIRECT TOWER ENERGY I/O COEFF	.23900000				-.04045000			.79545000
RELDC	DIESEL CHL PWR OUT / FUEL IN COEFF	.09750000				.63180000			-.41650000
RJACDC	DIESEL CHL JACKET HEAT/FUEL IN COEFF	.39220000				-.43670000			.27796000
RLUBDC	DIESEL CHL LUBE HEAT/FUEL IN COEFF	.88300000				-.13710000			.08030000
REXDC	DIESEL CHL EXH HEAT/FUEL IN COEFF	.31440000				-.13530000			.09726000
TEXDC	DIESEL CHL EXHAUST TEMP COEFF	1179.39600000				59.99940000			0.00000000
UACDC	DIESEL CHL STACK U-FAC AREA COEFF	.00952329				.00000000			0.00000000
FUL1GC	GAS TUR CHLR FUEL I/O COEFF (1-3)	9.41000000				-9.48000000			4.32000000
FUL2GC	GAS TUR CHLR FUEL I/O COEFF (4-6)	1.00440000				-.00080000			0.00000000
FEXGC	GAS TUR CHLR EXH FLOW COEFF	15.63518363				-.03059999			-.00020000
TEX1GC	GAS TUR CHLR EXH TEMP COEFF (1-3)	916.96200000				307.99800000			79.99200000
TEX2GC	GAS TUR CHLR EXH TEMP COEFF (4-6)	1.00500000				.00180000			0.00000000
ELUBGC	GAS TUR CHLR LUBE OI COEFF	.22300000				-.40000000			.22860000
UACGC	GAS TUR CHLR STACK U-FAC AREA COEFF	.01907045				.90000000			0.00000000
ADJTAC	AIR CLD CHLR COND COOL WTR T ADJ	95.00000000				1.19000000			43.98800000
RCVAVAC	AIR CLD CHLR CAP ADJ FACTOR	1.00600000				-.01900000			0.00220000
ADJEAC	AIR CLD CHLR ENERGY RATIO ADJ	3.15800000				-3.31300000			1.15400000
RPWRAC	AIR CLD CHLR ENERGY I/O COEFF	.23900000				-.04045000			.79545000
ADJTGC	GAS TUR CHLR COND COOL WTR T ADJ	95.00000000				1.19000000			43.98800000
RCVAVGC	GAS TUR CHLR CAPC ADJ FACTOR	1.00600000				-.01900000			0.00220000
ADJEGC	GAS TUR CHLR ENERGY RATIO ADJ	3.15800000				-3.31300000			1.15400000
RPWRGC	GAS TUR CHLR ENERGY I/O COEFF	.23900000				-.04045000			.79545000

Table 7

## Equipment Performance Parameter Applicability

PERFORMANCE PARAMETER	EQUIP TYPE	AIR COOLED CHILLER	BOILER	CHILLER	COLD STORAGE TANK	COOLING TOWER	DIESEL	DIESEL DRIVEN CHILLER	DIRECT COOLING TOWER	DOUBLE BUNDLE CHILLER	ELECTRIC BOILER	EVAPORATIVE CONDENSER	FREE COOLING CHILLER	GAS TURBINE	GAS TURBINE DRIVEN CHILLER	HEAT PUMP	HOT STORAGE TANK	ONE STAGE ABSORBER	OPEN CHILLER	RECIPROCATING CHILLER	SOLAR COLLECTOR	STEAM TURBINE	TWO STAGE ABSORBER	TWO STAGE ABSORBER W/RECON	WELL WATER CONDENSER	PUMPS
ADJEAC																										
ADJEDB																										
ADJEDC																										
ADJEPF																										
ADJEGC																										
ADJEHP																										
ADJEIC																										
ADJE2C																										
ADJE3C																										
ADJTAC																										
ADJTDB																										
ADJTDC																										
ADJTFC																										
ADJTGC																										
ADJTHP																										
ADJTIC																										
ADJT2C																										
ADJT3C																										
CAVPCM																										
CAVL1A																										
CPUMP																										
DTPUMP																										
ECUPMP																										
ELUBD																										
ELUBDC																										
FEHQ																										
FEHQC																										
FUEL1Q																										
FUEL2Q																										
FUL1QC																										
FUL2QC																										
HPUMP																										
HPWPCM																										
RCAVAC																										
RCAVDB																										
RCAVDC																										
RCAVPC																										
RCAVQC																										
RCAVHP																										
RCAVIC																										
RCAV2C																										
RCAV3C																										
RELD																										
RELDC																										
REN1A																										
REN2A																										
REN3AE																										
REXD																										
REXDC																										
RFUELB																										
RJACD																										
RIACDC																										
RLUBD																										
RLUBDC																										
RPWRAC																										
RPWRDB																										
RPWRDC																										
RPWRFC																										
RPWRQC																										
RPWRHP																										
RPWR1C																										
RPWR2C																										
RPWR3C																										
SOLAR																										
TEXD																										
TEXDC																										
TEX1Q																										
TEX2Q																										
TEX1QC																										
TEX2QC																										
TPUMP																										
UACD																										
UACDC																										
UACB																										
UACQC																										
WCPUMP																										



Table 8  
Default Reference Equipment Costs for New Equipment Types

E Q U I P M E N T	COST REFERENCE FOR EQUIPMENT (CH)							DATA		
	SIZE (KW)	UNIT COST (\$)	INITIAL COST FACTOR	CONSUM- ABLES (\$/HR)	MAINTA- NANCE (\$/YR)	ESMT LIFE (HR)	HPS TO MINOR CHARGE	MINOR CHARGE COST (\$)	HPS TO MAJOR CHARGE	MAJOR CHARGE COST (\$)
AIR COOLED CHILLER	3517.0	160,000	1.200	0.000	500.0	100000.	2000.	4000.	40000.	15,000.
DISTOL DRIVEN CHILLER	3517.0	160,000	1.200	1.500	700.0	20,000.	1000.	10000.	20,000.	80000.
DIRECT DRIVING POWER	3517.0	160,000	1.300	0.000	80.0	100000.	5000.	5000.	50000.	10000.
ELECTRIC PUMPER	11723.0	250,000	1.400	0.000	400.0	200000.	10000.	10000.	50,000.	10000.
EVAPORATIVE CONDENSER	3517.0	60,000	1.300	0.000	80.0	100000.	5000.	5000.	50000.	10000.
FREE COOLING CHILLER	3517.0	110,000	1.200	0.000	500.0	100000.	20000.	40000.	50000.	150000.
GAS TURBINE DRIVEN CHILLER	3517.0	300,000	1.300	1.500	500.0	100000.	20000.	50000.	50000.	250000.
WELL WATER CONDENSER	3517.0	60,000	1.300	0.000	80.0	100000.	5000.	5000.	50000.	150000.

CERL -- PLAST VERSION 3.0 PRELIMINARY

6 MAY 80

17.46.33.

PLANT LOADS NOT MET SUMMARY

MONTH	PLANT NUMBER *	4	MAIN PLANT	HEATING			COOLING			ELECTRIC		
				TOTAL LOAD NOT MET 1000BTU	PEAK LOAD NOT MET 1000BTU/HR	HOURS	TOTAL LOAD NOT MET 1000BTU	PEAK LOAD NOT MET 1000BTU/HR	HOURS	TOTAL LOAD NOT MET 1000BTU	PEAK LOAD NOT MET 1000BTU/HR	HOURS
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Figure 15. PLANT LOADS NOT MET report.

PLANT LOAD SUMMARY

PLANT NUMBER =	4	MAIN PLANT		
	TOTAL DEMAND 1000BTU	PEAK DEMAND 1000BTU/HR	TIME OF PEAK MO/DY/HR	
TOTAL HEATING DEMAND ON PLANT	.32203E+06	.93951E+02	12/31/ 8	
TOTAL COOLING DEMAND ON PLANT	.29162E+06	.67321E+02	8/ 8/14	
TOTAL ELECTRIC DEMAND ON PLANT	.18851E+06	.27683E+02	4/30/15	
TOTAL ELECTRIC PURCHASED FROM UTILITY	.18851E+06	.27683E+02	4/30/15	
TOTAL FIRED FUEL PURCHASED FROM UTILITY	0.	0.	0/ 0/ 0	
TOTAL GAS TURBINE FUEL PURCHASED FROM UTILITY	0.	0.	0/ 0/ 0	
TOTAL BOILER FUEL PURCHASED FROM UTILITY	.56541E+06	.13688E+03	12/31/ 8	
TOTAL STEAM PURCHASED FROM UTILITY	0.	0.	0/ 0/ 0	
TOTAL RECOVERED/PROCESS/ HEAT USED IN PLANT	0.	0.	0/ 0/ 0	

TOTAL ENERGY PURCHASED FOR USE IN PLANT = .75393E+06 1000BTU

TOTAL FLOOR AREA SERVED BY PLANT = .12000E+04 FT\*\*2

ENERGY BUDGET (TOTAL ENERGY / FLOOR AREA) = .62827E+03 1000BTU/FT\*\*2

NOTE: THIS ENERGY BUDGET DOES NOT INCLUDE ANY LOADS NOT MET  
OR ANY RECOVERED OR PROCESS WASTE ENERGY USED IN THE PLANT.

Figure 16. PLANT LOADS SUMMARY report.

## 7 CONCLUSION

BLAST Version 3.0 can be used to model passive solar applications and to analyze large-scale industrial facilities. Parameters users can study with BLAST Version 3.0 include (1) interzone heat transfer and ventilation, (2) movable insulation, (3) daylighting, (4) exact internal solar distribution, (5) radiant temperature control, (6) exterior radiant interchange, (7) mechanical ventilation, (8) process heat as heat source, (9) latent air-to-air heat recovery, (10) water-cooled packaged systems, (11) induction unit systems, (12) direct-drive chillers, and (13) purchased steam from utilities. BLAST Version 3.0 also offers the user a generalized report writer and several new output report options not available from BLAST Version 2.0.

Although the simulation capabilities of BLAST Version 3.0 are expanded over BLAST Version 2.0, users familiar with BLAST Version 2.0 can use Version 3.0 without modifying their approach or their BLAST input.

## APPENDIX A:

### WEATHER TAPE CONVERSION INPUT DATA FOR WIFE

(161-164)

For BLAST Version 3.0, the input card processor and the "bad data" replacing routines have been rewritten. In addition, the user may modify Version 2.0 weather files (WTHRFLs) with new holiday schedules.

#### WIFE Commands

The commands for WIFE may appear in any order and are separated by commas or semicolons. There are three ways to use the WIFE program:

1. To create a WTHRFL from an existing raw weather tape.
2. To modify an existing WTHRFL by replacing the existing holiday, special, or daylight savings time period with a new one.
3. To generate reports of calendar, daily, monthly, and hourly data during creation or modification, or as a stand-alone process.

Certain information is required during the creation process, e.g., tape type, station number, requested run period, latitudes, and longitude. Additionally, the user may input calendar-type data and request reports. During modification, only calendar data are changed on the existing WTHRFL; thus, commands specifying tape type, latitude, etc. are ignored. If only reports are being done from an existing WTHRFL, then input calendar data are ignored.

#### Report Commands

1. UNITS (METRIC): output units are expressed in SI units.
2. UNITS (ENGLISH): default output units are expressed in English units.
3. REPORT: a report is requested (one line per month).
4. DAILY (implies REPORT): a daily report is requested (1 line per day).
5. CALENDAR: a calendar is produced showing months, days, holidays, special days, and daylight savings time period.
6. HOURLY = single date: an hourly report (1 line per hour) is produced for a specified date.
7. HOURLY = FROM single date THRU single date: an hourly report is produced for a specified period.

### Tape Generation/Modification Commands

1. TITLE = "title for output WTHRFL."
2. RUN = FROM single date THRU single date: specifies run period for run. Default = 1JAN THRU 31DEC.
3. YEAR = year: year to be selected from raw data.
4. LATITUDE = number: latitude of the data ( $-90 \leq \text{lat} \leq 90$ ).
5. LONGITUDE = number: longitude of the data ( $-360 \leq \text{long} \leq 360$ ).
6. TIME ZONE = number: time zone (1 to 24).
7. TAPE = (tape type, station #): specifies tape type and station number.
8. Day type = single date: specifies special day type.
9. Day type = FROM single date THRU single date: specifies special day period.
10. DEFAULTS: specifies default holidays, daylight savings period.
11. MODIFY: specifies attached existing WTHRFL to be modified.

### Valid Tape Types

The station number in the following tape types specifies the WBAN number supplied on that particular tape.

1. 1440,T1440: tape type is NOAA TDF-1440.
2. TRY: NOAA Test Reference Year (TRY).
3. TMY: NOAA Test Meteorological Year (TMY).
4. SOLMET: NOAA Solar Radiation (SOLMET).
5. 280,T28: \* Solar Radiation 280 tapes.
6. OTHER:\*\* User-defined tape.

---

\* No 280 tapes can be used with TMY or SOLMET tapes.

\*\*For OTHER types, contact the local vendor or the BLAST representative.

### Valid Day Types\*

HOLIDAY (HOL)  
SPECIAL1 (SP1)  
SPECIAL2 (SP2)  
SPECIAL3 (SP3)  
SPECIAL4 (SP4)  
DAYLIGHT (DST): daylight savings time period.

### Defaults

Specifying DEFAULTS results in the following holidays and daylight savings time period.

#### Holidays

January 1 (or Friday preceding or Monday succeeding)  
November 11 (or Friday preceding or Monday succeeding)  
December 25 (or Friday preceding or Monday succeeding)  
July 4 (or Friday preceding or Monday succeeding)  
Third Monday in February  
Last Monday in May  
First Monday in September  
Second Monday in October  
Fourth Thursday in November

#### Daylight Savings Time

Last Sunday in April through last Sunday in October.

### Dates

Date forms are used to specify run period, dates for holiday or special day types, the daylight savings time period, and to select hourly report days. Dates can be specified in four ways:

1. Using a specific day and month, e.g., 1JAN or 1JANUARY
2. Using only numbers, e.g., 1/2 (February 1st).
3. Specifying a count of a specific day, e.g., "2ND TUES IN APR or 2ND TUESDAY IN APRIL," meaning the second Tuesday in April.
4. Specifying by position, e.g., "LAST SUN IN APR or FINAL SUNDAY OF APRIL," meaning the last Sunday in April.

\* Items enclosed in parentheses denote valid abbreviations.

### Holiday, Special Day Types, or Hourly Reports

The user enters holiday, special day types, or hourly report requests as:

request = single date

or

request = FROM single date THRU single date

For example:

HOLIDAY = 3RD MONDAY IN FEBRUARY,  
SPECIAL1 = FROM 1 AUG THRU 15 AUG,  
DST = FROM LAST SUN IN APR THRU LAST SUN IN OCT,  
HOURLY = FROM LAST SUN IN APR THRU 5 MAY,

### Run Period

For the run period (used in creating a new WTHRFL), only simple dates are allowed. For example:

RUN = FROM 1JAN THRU 31DEC,  
RUN = FROM 31OCT THRU 31MAR

### WIFE COMMANDS and Allowable Abbreviations

<u>Command</u>	<u>Allowable Abbreviations</u>
UNITS	UNIT
ENGLISH	ENG
METRIC	MET
REPORT	REP, SUMMARY
DAILY	DAY, DETAILS
CALENDAR	CAL, CALNDR
HOURLY	HR
FROM	
THRU	
TITLE	TIT
RUN	
YEAR	YR
LATITUDE	LAT
LONGITUDE	LONG
TIME ZONE	TIME, TIM, TIME ZONES
TAPE	TAP
DAYLIGHT	DST
HOLIDAY	HOL
SPECIAL1	SP1
SPECIAL2	SP2
SPECIAL3	SP3
SPECIAL4	SP4
DEFAULTS	DEF, DFLT5



MODIFY	MOD
JANUARY	JAN
FEBRUARY	FEB
MARCH	MAR
APRIL	APR
MAY	MY
JUNE	JUN
JULY	JUL
AUGUST	AUG
SEPTEMBER	SEP
OCTOBER	OCT
NOVEMBER	NOV
DECEMBER	DEC
SUNDAY	SUN
MONDAY	MON
TUESDAY	TUE
WEDNESDAY	WED
THURSDAY	THU
FRIDAY	FRI
SATURDAY	SAT
LAST	FINAL

BLAST Version 3.0 changes the example shown in the BLAST Version 2.0 Users Manual (Appendix A) as follows:

```

TITLE = "**TMY** FORT WORTH, TEXAS",
LAT = 32.75, LONG = 97.33, TIME = 6,
TAPE = (TMY, 03927), YEAR = 1979,
RUN = FROM 1 JAN THRU 31 DEC,
REPORT DAILY, DEFAULTS, UNITS (METRIC)

```

#### Control Cards

The raw data weather tape is local file WDATA. The 280 series solar tape is SDATA. Existing WTHRELS are local files OLWTHR. Output is written to local file WTHREL. Thus, the control card sequence is:

```

-- Job Card --
-- Account Card --
GET WDATA      for tape generation
GET SDATA
GET OLWTHR     for reporting, modifying
GET WIFE
WIFE.
Save WTHREL
FOR Card
WIFE Input
END Card

```

### Examples

1. A typical weather file generation run with special data period, hourly reports using a SOMET raw data tape:

```
-- Job Card --
-- Account card --
-- get WDATA
-- get WIFE
WIFE, INPUT, OUTPUT.
-- Save WTHREL
EOR Card
TITLE = "** SOLMET ** FORTWORTH, TEXAS",
LAT = 32.75, LONG = 97.33, TIME = 6,
TAPE = (SOLMET, 03927), YEAR = 1970,
RUN = FROM 1 JAN THRU 31 DEC, REPORT,
DAILY, UNITS (ENGLISH), DEFAULTS,
SPECIAL1 = FROM 1ST SUNDAY IN AUGUST
        THRU 3RD SUNDAY IN AUGUST,
CALENDAR, HOURLY = FROM 1 JAN THRU 5 JAN,
HOURLY = FROM LAST SUNDAY IN JUNE THRU
        1ST SUNDAY IN JULY,
EOI Card
```

2. A typical weather file modification run with some reporting:

```
-- Job Card --
-- Account Card --
-- get OLWTHR -- weather file to modify
-- get WIFE --
WIFE, INPUT, OUTPUT.
-- Save WTHREL
EOR Card
REPORT, DAILY, UNITS (ENGLISH), DEFAULTS,
MODIFY, SPECIAL1 = FROM 1 APR THRU 15 APR,
SPECIAL2 = 13 MAR, CALENDAR,
HOURLY = FROM 1 JAN THRU 5 JAN,
EOI Card
```

3. A typical weather file report generation run:

```
-- Job card --
-- Account card --
-- get OLWTHR --
-- get WIFE --
WIFE, INPUT, OUTPUT. --
EOR Card
REPORT, DAILY, UNITS (ENGLISH),
HOURLY = FROM 1ST TUESDAY IN SEP
        THRU 14 SEP,
EOI Card.
```

## APPENDIX B:

### OPERATION OF THE BLAST REPORT WRITER SYSTEM

(Not in the BLAST Version 2.0 Users Manual)

The BLAST Report Writer system allows the user to create additional output reports using the results of a BLAST simulation. The system has two program modules and uses four BLAST-generated files. The functions of the two main program modules are:

1. BLAST Report File Generator. During execution of the BLAST program, this module allows the user to select specific output variables from the building loads, systems, and plants segments of the program to be written to the BLAST report file during the BLAST simulation. The BLAST report file will contain the user-specified information for each design day simulated and the user-specified portion of the weather year simulation.

2. BLAST Report Writer: This program module uses any subset of the BLAST Report File (RPTFILE), the BLAST-generated building loads file (BLDFL), the BLAST-generated air-handler loads file (AHLDFL), and the BLAST weather file (WTHREFL) to create detailed, user-specified output reports. The BLAST Report Writer program module is a stand-alone program which includes an input processor, a set of routines for accessing the information on the BLAST-generated data files, and routines which produce a set of general reports. The BLAST Report Writer can be easily modified to include other user-defined output reports.

#### BLAST Report File Generator

The BLAST Report File Generator allows the user to select (from a specific list of allowable variables) the desired variables to be output hourly to the BLAST report file. These variables are selected during input processing by placing a special statement in the desired simulation input section. During input processing, the user may also request a reporting interval within a weather tape simulation (report records are created for all design days).

Desired variables for each of the three subprograms (loads, systems, and plants) will be selected by number from a list of all allowable variables for that subprogram. An example of the syntax for using the BLAST Report File Generator is in Figure B1.

In the example above, the user would create a BLAST report file containing the specified data for each subprogram for the two specified design days and the period 1 May through 31 July. If the user does not specify a desired report interval, the default is the entire simulation period. The desired report variables must be specified for each zone, system, and plant for which data are desired.

### BLAST Report File

The BLAST Report File is a random access file (on local file RPTFLE). The size of the file will vary depending on the number of days selected and the number of subprograms selecting report variables. However, because this file can easily grow larger than either the BLDFL or AHLDFL, users with restrictive system limits in file size must exercise caution.

An additional program allows the user to estimate the size of his RPTFLE, BLDFL, and AHLDFL. This program is completely interactive and prompts the user with questions. To access this program, the local support representative should be contacted.

### BLAST Syntax Codes

The allowable variable code numbers with descriptions, suggested output formats, units of variables and general report "short names" on the RPTFLE are shown in Figure B2. (Also see glossary P 109.) These are the codes used in the input of the zones, systems, or plants in the statement "REPORT VARIABLES = (code1, code2, ...);".

### BLAST Report Writer

The BLAST Report Writer contains an input processor for a user's input and a library of subprograms capable of reading the RPTFLE, BLDFL, AHLDFL, and WTHRFL. Weather data for each design day are in the BLDFL, AHLDFL, or RPTFLE.

The command language for the BLAST Report Writer is in the style of the BLAST input language. First, the report syntax is checked for errors, then the report is generated. Multiple reports may be requested in a single report writing run. And, as in the BLAST language, a "\*\*" will denote a comment line. If only a syntax check is desired, the user may execute the Report Writer with no files attached (e.g., no RPTFLE, WTHRFL, etc.).

The BLAST Report Writer allows the user to request variables from any or all of the BLAST-generated files listed above. Some general reports are provided to list user-specified variables.

The BLAST Report Writer has been structured to allow the user to create his own reports, if desired.

### BLAST Report Writer Command Language

The BLAST Report writer command language allows the user to access items from the BLAST-generated files. It also allows the user to select output units conversion, specify reporting period, frequency of reporting, and local title. These specifications are stored in program common areas until the actual report module is invoked. Each report module uses these settings to produce output reports.

The general form to invoke a report specification is the statement:

BEGIN REPORT (user-supplied report number)

and is terminated by:

END REPORT

Several standard reports are supplied with the BLAST Report Writer and more can be added, as necessary. The report numbers and descriptions for the standard reports are shown in Figure B3. Examples of each report are shown on pp 102 to 108.

Outputs in English units are specified by the statement:

UNITS = ENGLISH (default)

Outputs for System International (SI) units are specified by the statement:

UNITS = METRIC or  
UNITS = SI

The user can specify up to ten 80-character lines for a local title for the report by typing the statement:

TITLE = "string of characters."

The user specifies one or more of the following to select the environments for the reports:

RUN = ALL ENVIRONMENTS

implies all design days and at least some weather days as determined by the time period specification.

RUN = DESIGN DAYS

implies only the design days will be used to create the reports.

RUN = date or RUN = FROM date THRU date

selects a time period for the report; dates are input by specifying a day and month. For example:

RUN = 2/4 selects April 2.

RUN = FROM 2APRIL THRU 3MAY selects April 2 through May 3.

If no time period is specified, the default dates are the most restricted time span from the files needed for the report (i.e., all simulation days or all report days on RPTFLE, whichever is less). Specific design days may also be selected as

RUN = design day name 1, design day name 2;

(Note that the "," and ";" are required punctuation.) Thus, the user can select any sample of the environments on the files he wishes. For example, specifying:

RUN = ALL ENVIRONMENTS  
RUN = FROM 2APR THRU 4APR

displays the user-specified information (variable values) for all the design days and the weather period 2 to 4 April. The final results depend, of course, on the actual report module. The results of specifying the various RUN statements are shown in Figure B4.

The preceding commands provide the user with "specific" reports, i.e., reports 5 through 9 in Figure B3. Specific reports may allow the user little or no flexibility in choosing the information placed in the report. For example, report 9 (the weather report) places different information on an hourly report than on a daily report. However, a surface vertices report (report 8) will allow the user to select only certain zones to be reported (see syntax below).

General reports, on the other hand, allow the user much flexibility in reported information. The preceding commands are still sufficient to obtain a report, but only the first 11 variables (any RPTFLE variables followed by BLDFL or AHLDFL variables in numerical code order) will be displayed.

The actual time period may be restricted depending on the requested report, requested variables, and attached applicable files.

Frequency of reporting is specified by:

HOURLY -- Each hour's value is displayed  
DAILY -- A daily average, sum, minimum, and maximum  
are displayed  
MONTHLY -- A monthly average, sum, minimum, and maximum  
are displayed  
YEARLY -- Average, sum, minimum, and maximum are displayed  
for the user's specified weather period.

For each general report, a summary at the next level of frequency will also be displayed. Thus, if the user selects an HOURLY report, he will also see one unit of DAILY information for a summary (six actual lines). For general reports 1 through 4 averages, sums, minimum, and maximum are all displayed regardless of variables. For the weather report 9, averages and sums are displayed for appropriate variables.

The preceding commands are sufficient to provide the user with a report for all the sections and all variables applicable to his report. However, for

the general reports only the first 11 variables can be displayed. Thus, if the user inputs:

```
BEGIN REPORT (1)
  UNITS = ENGLISH
  HOURLY
  RUN = ALL ENVIRONMENTS
  TITLE = "MY ZONE REPORT"
END REPORT
```

he will receive a general zone report for all zones on the file for the first 11 variables (if more than 11 are available on the attached files) for all the design days and for the report file simulation period.

Much flexibility for selecting both simulation sections and report variables has been allowed in the command language. The actual simulation sections (zone, system, plant, zones served by systems, environments) and report variables displayed will be limited by (1) the actual report module and (2) whether the information is available on the attached BLAST-generated files. For example, if the user requests general report 1, he is limited to requesting (1) the zone variables specified in the ZONE input section of the BLAST run and (2) the variables on the BLDFL. However, the user need not display all the possible sections that may be stored on the RPTFLE, BLDFL, or AHLDFL. For example, variables for zones 1, 2, 3, 4 may be stored on both the BLDFL and RPTFLE, but the user may only wish to see variables for zones 1 and 4. The user would then input the statement:

```
FOR ZONES = (1, 4) REPORT
```

Additionally, the user may not wish to see all of the available variables. For example, the user may have stored zone variables 1 through 14 (see Figure B2) and may only wish to see variables 3, 7, and 12. To do this, the user inputs:

```
FOR ZONES = (1,4) REPORT VARIABLES = (3,7,12);
```

Note that the report variable codes are identical to the BLAST input codes shown in Figure B2.

The user may also access report variables from the BLAST-generated loads file (BLDFL or AHLDFL). The codes for requesting these variables are shown in Figure B5. For example,

```
FOR ZONES = (1,4), REPORT VARIABLES = (3,7,1001,1002)
```

In general, each selection of simulation sections or report variables may be qualified by a list of desired sections. Allowable section names are ZONES, SYSTEMS, PLANTS, ENVIRONMENTS. Thus, in general this statement is:

```
FOR section name [= (#,#,#,#).]* [SERVED BY SYSTEMS,]**
  REPORT (VARIABLES) [= (#,#,#,#)]*;
```

where:

- \* is optional, if omitted implies all
- \*\* is only applicable for selecting "system serving zone variables."

For example:

```
FOR SYSTEMS = (72), REPORT
```

selects all stored system variables for SYSTEM 72.

```
FOR ZONES = (1,2,3) SERVED BY SYSTEMS, REPORT VARIABLES - (7,12)
```

selects system serving zone variables 7 and 12 for zones 1, 2, and 3.

```
FOR PLANTS = (101,102,103), REPORT
```

selects REPORT all stored variables for plants 101, 102, and 103.

### Examples

A BLAST run has been executed saving the RPTFLE, BLDFL, and AHLDFL. The environments consist of two design days (COLUMBIA SUMMER, COLUMBIA WINTER) and a weather period of 10 April through 20 June of which 15 April through 19 June was saved on the RPTFLE.

To show the content of the various files, the user may input:

```
BEGIN REPORT 7
  UNITS = ENGLISH
END REPORT
```

and would receive the output shown in Figure B6.

Knowing the content of the files (either as shown before or from the BLAST run), the user might then request:

```
BEGIN REPORT 1
  UNITS = ENGLISH
  TITLE = "SAMPLE ZONE REPORT"
  RUN = ALL ENVIRONMENTS
  FOR ZONES = 2,3,4 REPORT
```

```
MONTHLY
END REPORT
```

and would receive the output shown in Figure B7.

As can be seen from the printed outputs, the user input commands are echoed on the printed output. Should an error occur in the user's syntax, only the report request containing the error would be omitted. Syntax scanning and output reporting would continue until the end of the user's input deck.

The examples in Figure B8 illustrate various combinations of inputs and resultant reports.



```

BEGIN INPUT;
RUN CONTROL ...
.
.
PROJECT - ...
DESIGN DAYS = SUMMER, WINTER;
WEATHER DATA FROM 01 JAN THRU 31 DEC;
REPORT FILE FROM 01 MAY THRU 31 JUL;
.
.
BEGIN BUILDING DESCRIPTION;
ZONE 1 "FIRST ZONE":
ORIGIN ...
.
.
.
PEOPLE = 25, CONSTANT;
LIGHTS = 10, CONSTANT;
REPORT VARIABLES = (2, 7, 11, 3);
END ZONE;
END BUILDING DESCRIPTION;
BEGIN FAN SYSTEM DESCRIPTION;
DX PACKAGED UNIT SYSTEM 1 "MAIN SYS" SERVING ZONE 1;
FOR ZONE 1:
.
.
.
REPORT VARIABLES = (1, 3, 7, 11);
END ZONE;
OTHER SYSTEM PARAMETERS:
.
.
.
REPORT VARIABLES = (1, 7, 16, 4);
END OTHER SYSTEM PARAMETERS;
END SYSTEM;
END FAN SYSTEM DESCRIPTION;
BEGIN CENTRAL PLANT DESCRIPTION;
PLANT 1 "MAIN PLANT" SERVING SYSTEM 1;
EQUIPMENT SELECTION:
.
.
.
END EQUIPMENT SELECTION;
OTHER PLANT PARAMETERS:
.
.
.
REPORT VARIABLES = (6, 8, 11, 1, 3);
END;
END PLANT;
END CENTRAL PLANT DESCRIPTION;
END INPUT;

```

to select  
ZONE  
variables

to select  
ZONE  
SERVED BY  
SYSTEM  
variables

to select  
SYSTEM  
variables

to select  
PLANT  
variables

Figure B1. BLAST Report File Generator syntax.

ZONE REPORT VARIABLES.....  
 CODE DESCRIPTION

FORMAT REPFLE UNITS

1	SURFACE VERTICES*		
2	NUMBER OF OCCUPANTS	(I12)	
3	CONVECTED HEAT GAIN FROM PEOPLE	(F11.3)	KWH
4	RADIATED HEAT GAIN FROM PEOPLE	(E11.3)	KWH
5	LATENT HEAT GAIN FROM PEOPLE	(F11.3)	KWH
6	ELECTRIC DEMAND FROM LIGHTS	(F11.3)	KWH
7	CONVECTED HEAT GAIN FROM LIGHTS	(E11.3)	KWH
8	RADIATED HEAT GAIN FROM LIGHTS	(E11.3)	KWH
9	VISIBLE HEAT GAIN FROM LIGHTS	(F11.3)	KWH
10	RETURN AIR GAIN FROM LIGHTS	(F11.3)	KWH
11	ELECTRIC DEMAND FROM ELECTRIC EQUIPMENT	(F11.3)	KWH
12	CONVECTED HEAT GAIN FROM ELECTRIC EQUIPMENT	(F11.3)	KWH
13	RADIATED HEAT GAIN FROM ELECTRIC EQUIPMENT	(E11.3)	KWH
14	LATENT HEAT GAIN FROM ELECTRIC EQUIPMENT	(F11.3)	KWH
15	GAS DEMAND FROM GAS EQUIPMENT	(E11.3)	KWH
16	CONVECTED HEAT GAIN FROM GAS EQUIPMENT	(E11.3)	KWH
17	RADIATED HEAT GAIN FROM GAS EQUIPMENT	(E11.3)	KWH
18	LATENT HEAT GAIN FROM GAS EQUIPMENT	(E11.3)	KWH
19	CONVECTED HEAT GAIN FROM OTHER EQUIPMENT	(E11.3)	KWH
20	RADIATED HEAT GAIN FROM OTHER EQUIPMENT	(F11.3)	KWH
21	LATENT HEAT GAIN FROM OTHER EQUIPMENT	(E11.3)	KWH
22	CONVECTED BASEBOARD HEAT LOAD	(E11.3)	KWH
23	RADIATED BASEBOARD HEAT LOAD	(E11.3)	KWH
24	MEAN RADIANT TEMPERATURE	(F11.2)	CENTIGRADE
25	TOTAL SOLAR GAIN	(E11.3)	KWH
26	AMOUNT OF SOLAR GAIN IN DRAPES	(E11.3)	KWH
27	AMOUNT OF SOLAR GAIN IN WALLS	(F11.3)	KWH

Figure B2. BLAST syntax codes.

SYSTEM REPORT VARIABLES.....

CODE	DESCRIPTION	FORMAT	REFLE UNITS
1	ENTERING AIR TEMPERATURE FOR COOLING COIL	(F11,2)	CENTIGRADE
2	ENTERING HUMIDITY RATIO FOR COOLING COIL	(F11,4)	
3	LEAVING AIR TEMPERATURE FOR COOLING COIL	(F11,2)	CENTIGRADE
4	LEAVING HUMIDITY RATIO FOR COOLING COIL	(F11,4)	
5	AIR MASS FLOW RATE THRU COOLING COIL	(F11,3)	KG/SEC
6	TOTAL LOAD ON COOLING COIL	(F11,3)	KWH
7	ENTERING AIR TEMPERATURE FOR HEATING COIL	(F11,2)	CENTIGRADE
8	LEAVING AIR TEMPERATURE FOR HEATING COIL	(F11,2)	CENTIGRADE
9	LEAVING AIR HUMIDITY RATIO FOR HEATING COIL	(F11,4)	
10	AIR MASS FLOW RATE OVER HEATING COIL	(F11,3)	KG/SEC
11	TOTAL LOAD ON HEATING COIL	(F11,3)	KWH
12	MIXED AIR TEMPERATURE	(F11,2)	CENTIGRADE
13	MIXED AIR HUMIDITY RATIO	(F11,4)	
14	DESIRED MIXED AIR TEMPERATURE	(F11,2)	CENTIGRADE
15	FRACTION OF MIXED AIR FROM OUTSIDE AIR	(F11,2)	
16	LEAVING HUMIDITY RATIO FROM HUMIDIFIER	(F11,4)	
17	TOTAL LOAD ON HUMIDIFIER	(E11,3)	KWH
18	WATER ADDED BY HUMIDIFIER	(F11,2)	M**3
19	ELECTRIC DEMAND OF DX CONDENSING UNIT	(E11,3)	KWH
20	ELECTRIC DEMAND OF HEAT RECOVERY DEVICE	(E11,3)	KWH
21	HEAT RECOVERED FROM RELIEF AIR	(E11,3)	KWH
22	TOTAL LOAD ON PREHEAT COIL	(E11,3)	KWH
23	SUPPLY FAN POWER	(E11,3)	KWH
24	RETURN FAN POWER	(E11,3)	KWH
25	EXHAUST FAN POWER	(E11,3)	KWH
26	TOTAL SUPPLY AIR MASS FLOW RATE	(E11,3)	KG/SEC
27	TOTAL RETURN AIR MASS FLOW RATE	(E11,3)	KG/SEC
28	TOTAL EXHAUST AIR MASS FLOW RATE	(E11,3)	KG/SEC
29	TOTAL RETURN AIR HUMIDITY RATIO	(F11,4)	
30	TOTAL RETURN AIR TEMPERATURE	(F11,2)	CENTIGRADE

ZONE IN SYSTEM REPORT VARIABLES.....

CODE	DESCRIPTION	FORMAT	REFLE UNITS
1	THERMOSTAT BASEBOARD HEAT DEMAND	(E11,3)	KWH
2	PREHEAT COIL/FAN COIL HEATING DEMAND	(E11,3)	KWH
3	RECOOL COIL/FAN COIL COOLING DEMAND	(E11,3)	KWH
4	ZONE HEATING LOAD NOT MET	(E11,3)	KWH
5	ZONE COOLING LOAD NOT MET	(E11,3)	KWH
6	DESIRED SUPPLY AIR TEMPERATURE	(F11,2)	CENTIGRADE
7	RETURN AIR TEMPERATURE	(F11,2)	CENTIGRADE
8	RETURN AIR HUMIDITY RATIO	(F11,4)	
9	SUPPLY AIR MASS FLOW RATE	(E11,3)	KG/SEC
10	RETURN AIR MASS FLOW RATE	(E11,3)	KG/SEC
11	EXHAUST AIR MASS FLOW RATE	(E11,3)	KG/SEC
12	FINAL HUMIDITY RATIO	(F11,4)	

Figure B2. (Cont'd).

PLANT REPORT VARIABLES.....  
CODE DESCRIPTION

FORMAT REPFLE UNITS

1	HEATING DEMAND FROM ALL FAN SYSTEMS	(E11.3)	KWH
2	COOLING DEMAND FROM ALL FAN SYSTEMS	(E11.3)	KWH
3	ELECTRIC DEMAND FROM ALL FAN SYSTEMS	(E11.3)	KWH
4	FUEL DEMAND FROM ALL FAN SYSTEMS	(E11.3)	KWH
5	TOTAL HEAT DEMAND	(F11.3)	KWH
6	TOTAL COOLING DEMAND	(E11.3)	KWH
7	TOTAL ELECTRIC DEMAND	(E11.3)	KWH
8	TOTAL FUEL DEMAND	(E11.3)	KWH
9	TOTAL HEAT RECOVERED BY PLANT	(E11.3)	KWH
10	RECOVERABLE HEAT WASTED BY PLANT	(E11.3)	KWH
11	HEAT AVAILABLE FOR STORAGE	(E11.3)	KWH
12	HEAT ACTUALLY STORED AS AND/OR COLD	(E11.3)	KWH
13	GAS TURBINE EXHAUST HEAT RECOVERABLE	(E11.3)	KWH
14	DIESEL EXHAUST HEAT RECOVERABLE	(E11.3)	KWH
15	GAS TURBINE LUBE HEAT RECOVERABLE	(E11.3)	KWH
16	DIESEL LUBE HEAT RECOVERABLE	(E11.3)	KWH
17	DIESEL JACKET HEAT RECOVERABLE	(F11.3)	KWH
18	STEAM TURBINE HEAT RECOVERABLE	(E11.3)	KWH
19	EXTRACTION STEAM TURBINE HEAT RECOVERABLE	(E11.3)	KWH
20	GAS TURBINE CHILLER EXHAUST HEAT RECOVERABLE	(E11.3)	KWH
21	DIESEL CHILLER EXHAUST HEAT RECOVERABLE	(E11.3)	KWH
22	GAS TURBINE CHILLER LUBE HEAT RECOVERABLE	(E11.3)	KWH
23	DIESEL CHILLER LUBE HEAT RECOVERABLE	(E11.3)	KWH
24	DIESEL CHILLER JACKET HEAT RECOVERABLE	(E11.3)	KWH
25	STEAM TURBINE CHILLER HT	(E11.3)	KWH
26	EXTRACTION STEAM TURBINE CHILLER HEAT RECOVERABLE	(E11.3)	KWH
27	DOUBLE BUNDLE CHILLER HEAT RECOVERABLE	(E11.3)	KWH
28	RECOVERABLE HEAT WASTED BY DOUBLE BUNDLE CHILLER	(E11.3)	KWH
29	HEAT PUMP HEAT RECOVERABLE	(E11.3)	KWH
30	RECOVERABLE HEAT WASTED BY HEAT PUMP	(E11.3)	KWH
31	CHILLED WATER PUMP POWER	(E11.3)	KWH
32	HOT WATER PUMP POWER	(E11.3)	KWH
33	SOLAR PUMP POWER	(E11.3)	KWH
34	TOTAL COLLECTABLE SOLAR ENERGY	(F11.3)	KWH
35	SOLAR ENERGY WASTED	(E11.3)	KWH
36	TANK TEMPERATURE	(F11.2)	CENTIGRADE
37	SOLAR FOR COOLING	(E11.3)	KWH
38	SOLAR FOR HEATING	(E11.3)	KWH
39	SOLAR FOR DOMESTIC HOT WATER	(E11.3)	KWH
40	SOLAR FOR FALSE LOADING HEAT PUMP	(E11.3)	KWH
42	GAS DOMESTIC HOT WATER DEMAND	(E11.3)	KWH
43	ELECTRIC DOMESTIC HOT WATER DEMAND	(E11.3)	KWH
44	COOLING TOWER ENTERING WATER TEMPERATURE	(F11.2)	CENTIGRADE
45	COOLING TOWER LEAVING WATER TEMPERATURE	(F11.2)	CENTIGRADE
46	COOLING TOWER CONDENSER WATER FLOW RATE	(E11.3)	KG/SEC
47	EVAPORATIVE CONDENSER ENTERING WATER TEMPERATURE	(F11.2)	CENTIGRADE
48	EVAPORATIVE CONDENSER LEAVING WATER TEMPERATURE	(F11.2)	CENTIGRADE
49	EVAPORATIVE CONDENSER WATER FLOW RATE	(E11.3)	KG/SEC
50	WELL WATER CONDENSER LEAVING WATER TEMPERATURE	(F11.2)	CENTIGRADE
51	WELL WATER CONDENSER FLOW RATE	(F11.3)	KG/SEC
52	EQUIPMENT OPERATING CAPACITY	(E11.3)	KWH
53	DEMAND ON EQUIPMENT TYPES	(F11.3)	KWH
54	LOAD MET BY EQUIPMENT TYPES	(F11.3)	KWH
55	ELECTRIC POWER CONSUMED BY EQUIPMENT TYPES	(F11.3)	KWH
56	FUEL CONSUMED BY EQUIPMENT TYPES	(F11.3)	KWH
57	NUMBER OF EACH SIZE OF EQUIPMENT OPERATING	(F11.0)	

Figure B2. (Cont'd).

<u>Report Number</u>	<u>Description</u>	<u>Files Used</u>
1	Zone Variable Report	RPTFLE, BLDFL
2	System Variable Report	RPTFLE, AHLDFL
3	Plant Variable Report	RPTFLE
4	Zones Served By System Variable Report	RPTFLE, AHLDFL
5	Plant Equipment Report	RPTFLE
6	Zone Peak Report	BLDFL
7	Content Report	All attached files
8	Surface Vertices Report	RPTFLE, BLDFL
9	Weather Report	BLDFL or AHLDFL and/or WTHRFL

Figure B3. Supplied numbers and description.

<u>Run Specification</u>	<u>Outline</u>
Run = ALL ENVIRONMENTS	All design days and default time period.
Run = ALL ENVIRONMENTS Run = <DATE> OR Run = ALL ENVIRONMENTS Run = FROM <DATE> thru <DATE>	All design days and specified time period.
Run = Design Days	All design days; no weather days.
Run = <DATE> OR Run = FROM <DATE> thru <DATE>	No design days; specified time period.
No Run specification	No design days; default time period.

Figure B4. Results of specifying various RUN statements.

#### ZONE (BLDFL) REPORT VARIABLES

CODE	SHORT NAME	DESCRIPTION	FORMAT	BLDFL UNITS
1001	ZNSEHTLD	ZONE SENSIBLE HEATING LOAD	(E11.3)	KWH
1002	ZNSECLLD	ZONE SENSIBLE COOLING LOAD	(E11.3)	KWH
1003	ZNLATLD	ZONE LATENT LOAD	(E11.3)	KWH
1004	ZNRAIRHTL	ZONE RETURN AIR HEATING LOAD	(E11.3)	KWH
1005	ZNBASEHTL	ZONE BASEBOARD HEATING LOAD	(E11.3)	KWH
1006	ZNELECLD	ZONE ELECTRICAL LOAD	(E11.3)	KWH
1007	ZNGASLD	ZONE GAS LOAD	(E11.3)	KWH
1008	ZNINFIL	ZONE INFILTRATION (MASS FLOW RATE)	(E11.3)	KG/SEC
1009	ZONE TEMP	ZONE TEMPERATURE	(F11.2)	CENTIGRADE
1010	ATTIC TEMP	ATTIC TEMPERATURE	(F11.2)	CENTIGRADE
1011	CRAWL TEMP	CRAWL SPACE TEMPERATURE	(F11.2)	CENTIGRADE

#### SYSTEM (AHLDFL) REPORT VARIABLES

CODE	SHORT NAME	DESCRIPTION	FORMAT	AHLDFL UNITS
2001	SYSHEATLD	SYSTEM HEATING LOAD	(E11.3)	KWH
2002	SYSCOOLLD	SYSTEM COOLING LOAD	(E11.3)	KWH
2003	SYSGASLD	SYSTEM GAS LOAD	(E11.3)	KWH
2004	SYSELECLD	SYSTEM ELECTRIC LOAD	(E11.3)	KWH
2005	AIRHANDTYPE	AIR HANDLER TYPE	(F11.0)	

Figure B5. BLAST codes for accessing report variables.

BLAST REPORT WRITER VERSION 1.0 PRELIMINARY 28 JUL 80 14.31.67.

1 BEGIN REPORT

2 UNITS = ENGLISH

3 END REPORT

BLAST REPORT WRITER VERSION 1.0 PRELIMINARY 28 JUL 80 14.31.08.

\* \* \* \* \* CONTENT REPORT \* \* \*

\* \* \* \* \*

BLDFL FOR  
WORKSHOP OFFICE MODULE

LOCATION COLUMBIA, MO TRY 1968 LAT= 39.00000 LONG= 92.33000 TIME ZONE= 6.0  
DATE OF FILE CREATE/UPDATE 10 JUN 80 NUMBER OF ENVIRONMENTS 3  
NUMBER OF ZONES 4 WITH ZONE NUMBERS  
1 2 3 4

THIS BLDFL HAS ZONE ID RECORDS FOR THE ABOVE ZONES.

\* \* \* \* \*

AHDFL FOR  
WORKSHOP OFFICE MODULE

LOCATION COLUMBIA, MO TRY 1968 LAT= 39.00000 LONG= 92.33000 TIME ZONE= 6.0  
DATE OF FILE CREATE/UPDATE 10 JUN 80 NUMBER OF ENVIRONMENTS 3  
NUMBER OF SYSTEMS 1 WITH SYSTEM NUMBERS  
1

THIS AHDFL HAS SYSTEM ID RECORDS FOR THE ABOVE SYSTEMS.

\* \* \* \* \*

WHAFL FOR  
COLUMBIA, MO TRY 1968  
WEATHER STATION= 13981 LAT= 39.00000 LONG= 92.33000 TIME ZONE= 6.0  
NUMBER OF DAYS=366 FROM 1 JAN 68 THRU 31 DEC 68

\* \* \* \* \*

PPDFL FOR  
WORKSHOP OFFICE MODULE

LAT= 39.00000 LONG= 92.33000 TIME ZONE= 6.0  
DATE OF FILE CREATION 10 JUN 80 FOR 12 DESIGN DAYS AND 66 WEATHER TAPE DAYS FROM 15 APR 68 THRU 19 JUN 68  
NUMBER OF ZONES= 4 NUMBER OF SYSTEMS= 1 NUMBER OF PLANTS= 1  
BUILDING SURFACE ZONE VERTICES SAVED FOR 31 ZONE SURFACES

INFORMATION HAS BEEN SAVED FOR ZONE NUMBERS--  
1 2 3 4

VARIABLES FOR ZONE 1 ARE-- (CODE=SHORT NAME)  
1=VERTICES 2=NOOCCUPANTS 3=CONHEATQCC 4=RADHEATQCC 5=LATHEATQCC 6=ELEGMDLTS 7=CONHEATLTS 8=RADHEATLTS  
9=VTSHEATLTS 10=RETAINLTS 25=TOTSOLAR

Figure B6. Output example 1.

DERL - PLAS REPORT WRITER VERSION 1.0 PRELIMINARY 26 JUL 80 14.31.08.

VARIABLES FOR ZONE 1 ARE-- (CODE=SHORT NAME)  
 1=NOCCUPANTS 3=CONHEATCC 4=RADHEATCC 5=LATHEATCC 6=ELECDMDLTS 7=CONHEATLTS 8=RADHEATLTS 9=VISHEATLTS  
 10=RETALR+LTS 25=TOTSOLAR+

VARIABLES FOR ZONE 2 ARE-- (CODE=SHORT NAME)  
 1=NOCCUPANTS 3=CONHEATCC 4=RADHEATCC 5=LATHEATCC 6=ELECDMDLTS 7=CONHEATLTS 8=RADHEATLTS 9=VISHEATLTS  
 10=RETALR+LTS 25=TOTSOLAR+

VARIABLES FOR ZONE 4 ARE-- (CODE=SHORT NAME)  
 1=NOCCUPANTS 3=CONHEATCC 4=RADHEATCC 5=LATHEATCC 6=ELECDMDLTS 7=CONHEATLTS 8=RADHEATLTS 9=VISHEATLTS  
 10=RETALR+LTS 25=TOTSOLAR+

INFORMATION HAS BEEN SAVED FOR SYSTEM NUMBERS--  
 72

VARIABLES FOR SYSTEM 72 ARE-- (CODE=SHORT NAME)  
 1=INAIR CC 2=INHUMR CC 3=OUTAIR CC 4=OUTHUMR CC 5=AIR MFR CC 6=TOT COL LE 10=AIR MFR HC 11=TOTHEATLE

INFORMATION HAS BEEN SAVED FOR THE FOLLOWING ZONES SERVED BY SYSTEM 72--  
 1 2 3 4

VARIABLES FOR ZONE 1 ARE-- (CODE=SHORT NAME)  
 1=THEMABASE 2=PEHEATCC 3=RECOCOLCC 4=HUMMET HEAT 5=HUMMET COOL 6=DESSUPAIR 7=RETALRTMP 8=RETALRHUMR  
 9=SUPAIR MFR 10=RETALR MFR 11=EXAIR MFR 12=FINAL HUMR

VARIABLES FOR ZONE 2 ARE-- (CODE=SHORT NAME)  
 1=THEMABASE 2=PEHEATCC 3=RECOCOLCC 4=HUMMET HEAT 5=HUMMET COOL 6=DESSUPAIR 7=RETALRTMP 8=RETALRHUMR  
 9=SUPAIR MFR 10=RETALR MFR 11=EXAIR MFR 12=FINAL HUMR

VARIABLES FOR ZONE 3 ARE-- (CODE=SHORT NAME)  
 1=THEMABASE 2=PEHEATCC 3=RECOCOLCC 4=HUMMET HEAT 5=HUMMET COOL 6=DESSUPAIR 7=RETALRTMP 8=RETALRHUMR  
 9=SUPAIR MFR 10=RETALR MFR 11=EXAIR MFR 12=FINAL HUMR

VARIABLES FOR ZONE 4 ARE-- (CODE=SHORT NAME)  
 1=THEMABASE 2=PEHEATCC 3=RECOCOLCC 4=HUMMET HEAT 5=HUMMET COOL 6=DESSUPAIR 7=RETALRTMP 8=RETALRHUMR  
 9=SUPAIR MFR 10=RETALR MFR 11=EXAIR MFR 12=FINAL HUMR

INFORMATION HAS BEEN SAVED FOR PLANT NUMBERS  
 4

VARIABLES FOR PLANT 4 ARE-- (CODE=SHORT NAME)  
 1=FANHEAT 2=FANCOOL 3=FANELEC 4=FANVELT 53=EQ DEMAND 54=EQ LOADMET 55=EQ PURNET

Figure B6. (Cont'd).



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1 BEGIN REPORT 1  
2 UNITS = ENGLISH  
3 TITLE = "SAMPLE ZONE REPORT"  
4 RUN = ALL ENVIRONMENTS  
5 FOR ZONES = 2,3,4 REPORT  
6 MONTHLY  
7 END REPORT

\*\*\*\*REPORT END DATE EXCEEDS REPORT FILE END DATE. RESET TO REPORT FILE END DATE OF 19/ 6/68 (DD/MM/YY)  
\*\*\*\*REPORT START DATE PRECEEDFD REPORT FILE START DATE. RESET TO REPORT START DATE OF 15/ 4/68 (DD/MM/YY)

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# SAMPLE ZONE REPORT

ENVIRONMENT 1 ZONE 2 MONTHLY FROM 1 21 1980 LHRU 1 21 1980

MONTH	NOOCCUPANTS	CONHEATOC	RADHEATOC	LAHEATOC	HEZEMPUS	CONHEATIS	RADHEATIS	VISHEATIS	RETAIRLIS	TOTSOLAR
	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU
1										
MTH MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	2.540E+03
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR13
MTH MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24
MTH SUMS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	4.919E+04
MTH AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	2.050E+01
YR MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	2.540E+03
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR13
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24
YR SUMS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	4.919E+04
YR AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	2.050E+01

Figure B7. Output example 2.

AD-A099 054 CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAIGN IL F/6 9/2  
BUILDING LOADS ANALYSIS AND SYSTEM THERMODYNAMICS (BLAST) PROGR--ETC(U)  
MAR 81 D HERRON, G WALTON, L LAWRIE FY7615-79-05134  
UNCLASSIFIED CERL-TR-E-171-VOL-1 NL

CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAIGN IL F/G 9/2  
BUILDING LOADS ANALYSIS AND SYSTEM THERMODYNAMICS (BLAST) PROGR--ETC(U)  
MAR 81 D HERRON, G WALTON, L LAWRIE FY7615-79-05134  
CERL-TR-E-171-VOL-1 NL

**UNCLASSIFIED**

CERL-TR-E-171-VOL-1

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ENVIRONMENT 1 ZONE 3 MONTHLY FROM 1/21/1980 THRU 1/21/1980

MONTH	NOCCUPANTS	CONHEATOC	RADHEATOC	LATHEATOC	ELECDBLTS	CONHEATLTS	RADHEATLTS	VISHEATLTS	RETAIR+LTS	TOTSOLAR+
	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU
1										
MTH MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	5.862E+02
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR13
MTH MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24
MTH SUNS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	3.745E+03
MTH AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.561E+02
YR MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	5.862E+02
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR13
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24
YR SUNS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	3.745E+03
YR AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.561E+02

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#### SAMPLE ZONE REPORT

ENVIRONMENT 1 ZONE 4 MONTHLY FROM 1/21/1980 THRU 1/21/1980

MONTH	NOCCUPANTS	CONHEATOC	RADHEATOC	LATHEATOC	ELECDBLTS	CONHEATLTS	RADHEATLTS	VISHEATLTS	RETAIR+LTS	TOTSOLAR+
	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU
1										
MTH MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	5.862E+02
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR13
MTH MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24
MTH SUNS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	3.745E+03
MTH AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.561E+02
YR MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	5.862E+02
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR13
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24	1/21 HR24
YR SUNS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	3.745E+03
YR AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.561E+02

Figure B7. (Cont'd).

## SAMPLE ZONE REPORT

ENVIRONMENT 2 ZONE 2 MONTHLY FROM 7/21/1980 THRU 7/21/1980

MONTH	#OCCUPANTS	CONHEATOC	RADHEATOC	LATHEATOC	ELECDBLTS	CONHEATLS	RADHEATLS	VISHEATLS	RETAIR*LS	TOTSOLAR*
	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU
7										
MTH MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.664E+03
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR13
MTH MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24
MTH SUMS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	1.210E+04
MTH AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	5.041E+02

YR MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.664E+03
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR13
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24
YR SUMS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	1.210E+04
YR AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	5.041E+02

ENVIRONMENT 2 ZONE 3 MONTHLY FROM 7/21/1980 THRU 7/21/1980

MONTH	#OCCUPANTS	CONHEATOC	RADHEATOC	LATHEATOC	ELECDBLTS	CONHEATLS	RADHEATLS	VISHEATLS	RETAIR*LS	TOTSOLAR*
	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU
7										
MTH MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.386E+03
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR12
MTH MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24
MTH SUMS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	1.056E+04
MTH AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	4.400E+02

YR MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.386E+03
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR12
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24
YR SUMS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	1.056E+04
YR AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	4.400E+02

Figure B7. (Cont'd).

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SAMPLE ZONE REPORT

ENVIRONMENT 2 ZONE 4 MONTHLY FROM 7/21/1980 THRU 7/21/1980

MONTH	OCCUPANTS 1000BTU	CONHEATCC 1000BTU	RADHEATCC 1000BTU	LATHEATCC 1000BTU	ELECDHDLTS 1000BTU	CONHEATLTS 1000BTU	RADHEATLTS 1000BTU	VISHEATLTS 1000BTU	RETAIR+LTS 1000BTU	TOTSOLAR+ 1000BTU
7										
MTM MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.386E+03
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR12
MTM MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24
MTM SUMS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	1.056E+04
MTM AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	4.400E+02
YR MAX	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	1.386E+03
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR12
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24	7/21 HR24
YR SUMS	0.00	0.	0.	0.	2.040E+03	1.224E+03	4.080E+02	4.080E+02	0.	1.056E+04
YR AVGS	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	4.400E+02

Figure B7. (Cont'd).

## SAMPLE ZONE REPORT

ENVIRONMENT 3 ZONE, 2 MONTHLY FROM 4/15/1968 THRU 6/19/1968

MONTH	OCCUPANTS	CONHEATOC	RADHEATOC	LATHEATOC	ELECTRMLTS	CONHEATLS	RADHEATLS	VISHEATLS	RETAIR+LTS	TOISOLAR+
	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU
<hr/>										
4										
MTN MAX	2.00	1.499E+02	3.498E+02	4.191E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.699E+03
	4/30 HR15	4/24 HR 9	4/24 HR 9	4/17 HR16	4/30 HR16	4/30 HR16	4/30 HR16	4/30 HR16	4/30 HR24	4/15 HR13
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24
MTN SUMS	208.80	1.571E+04	3.665E+04	4.161E+04	2.387E+05	1.432E+05	4.774E+04	4.774E+04	0.	1.871E+05
MTN AVGS	.54	4.091E+01	9.545E+01	1.083E+02	6.216E+02	3.729E+02	1.243E+02	1.243E+02	0.	4.873E+02
5										
MTN MAX	2.00	1.499E+02	3.498E+02	4.254E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.541E+03
	5/31 HR15	5/20 HR 8	5/20 HR 8	5/15 HR15	5/31 HR16	5/31 HR16	5/31 HR16	5/31 HR16	5/31 HR24	5/29 HR12
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24
MTN SUMS	382.80	2.837E+04	6.621E+04	7.769E+04	4.410E+05	2.646E+05	8.820E+04	8.820E+04	0.	3.718E+05
MTN AVGS	.51	3.814E+01	8.899E+01	1.044E+02	5.927E+02	3.556E+02	1.185E+02	1.185E+02	0.	4.997E+02
6										
MTN MAX	2.00	1.466E+02	3.422E+02	4.328E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.559E+03
	6/19 HR15	6/17 HR 8	6/17 HR 8	6/10 HR 8	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR24	6/18 HR13
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24
MTN SUMS	226.20	1.607E+04	3.738E+04	4.839E+04	2.620E+05	1.572E+05	5.239E+04	5.239E+04	0.	2.390E+05
MTN AVGS	.50	3.513E+01	8.198E+01	1.061E+02	5.745E+02	3.447E+02	1.149E+02	1.149E+02	0.	5.241E+02
<hr/>										
YR MAX	2.00	1.499E+02	3.498E+02	4.328E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.699E+03
	6/19 HR15	5/20 HR 8	5/20 HR 8	6/10 HR 8	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR24	4/15 HR13
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24
YR SUMS	817.80	6.010E+04	1.402E+05	1.677E+05	9.416E+05	5.650E+05	1.883E+05	1.883E+05	0.	7.979E+05
YR AVGS	.52	3.794E+01	8.854E+01	1.039E+02	5.945E+02	3.567E+02	1.189E+02	1.189E+02	0.	5.037E+02

Figure B7. (Cont'd).

## SAMPLE ZONE REPORT

ENVIRONMENT 3 ZONE 3 MONTHLY FROM 4/15/1968 THRU 6/19/1968

MONTH	NOOCCUPANTS	CONHEATCC 1000BTU	RADHEATCC 1000BTU	LATHEATCC 1000BTU	ELECNDLT 1000BTU	CONHEATLS 1000BTU	RADHEATLS 1000BTU	VISHEATLS 1000BTU	RETAIR+LTS 1000BTU	TOTSOLAR+ 1000BTU
<hr/>										
4										
MTN MAX	2.00	1.499E+02	3.498E+02	4.185E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.455E+03
	4/30 HR15	4/24 HR 9	4/24 HR 9	4/17 HR16	4/30 HR16	4/30 HR16	4/30 HR16	4/30 HR16	4/30 HR24	4/30 HR13
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24
MTN SUMS	208.80	1.572E+04	3.668E+04	4.157E+04	2.387E+05	1.432E+05	4.774E+04	4.774E+04	0.	1.758E+05
MTN AVGS	.54	4.093E+01	9.551E+01	1.083E+02	6.216E+02	3.729E+02	1.243E+02	1.243E+02	0.	4.578E+02
5										
MTN MAX	2.00	1.498E+02	3.495E+02	4.254E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.541E+03
	5/31 HR15	5/20 HR 8	5/20 HR 8	5/15 HR15	5/31 HR16	5/31 HR16	5/31 HR16	5/31 HR16	5/31 HR24	5/29 HR12
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24
MTN SUMS	382.80	2.838E+04	6.621E+04	7.768E+04	4.410E+05	2.646E+05	8.820E+04	8.820E+04	0.	3.768E+05
MTN AVGS	.51	3.814E+01	8.899E+01	1.044E+02	5.927E+02	3.556E+02	1.185E+02	1.185E+02	0.	5.064E+02
6										
MTN MAX	2.00	1.465E+02	3.419E+02	4.335E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.559E+03
	6/19 HR15	6/17 HR 8	6/17 HR 8	6/10 HR 8	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR24	6/13 HR13
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24
MTN SUMS	226.20	1.601E+04	3.736E+04	4.842E+04	2.620E+05	1.572E+05	5.239E+04	5.239E+04	0.	2.510E+05
MTN AVGS	.50	3.511E+01	8.193E+01	1.062E+02	5.745E+02	3.447E+02	1.149E+02	1.149E+02	0.	5.503E+02
<hr/>										
YR MAX	2.00	1.499E+02	3.498E+02	4.335E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.559E+03
	6/19 HR15	4/24 HR 9	4/24 HR 9	6/10 HR 8	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR24	6/13 HR13
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24
YR SUMS	817.80	6.011E+04	1.402E+05	1.677E+05	9.416E+05	5.650E+05	1.883E+05	1.883E+05	0.	8.035E+05
YR AVGS	.52	3.795E+01	8.854E+01	1.059E+02	5.945E+02	3.567E+02	1.189E+02	1.189E+02	0.	5.073E+02

Figure B7. (Cont'd)

## SAMPLE ZONE REPORT

ENVIRONMENT 3 ZONE 4 MONTHLY FROM 4/15/1968 THRU 6/19/1968

MONTH	OCCUPANTS	CONHEATCC 1000BTU	RADHEATCC 1000BTU	LATHEATCC 1000BTU	ELECRLDLS 1000BTU	CONHEATLS 1000BTU	RADHEATLS 1000BTU	VISHEATLS 1000BTU	RETAIR+LTS 1000BTU	TOTSOLAR+ 1000BTU
<hr/>										
4										
MTN MAX	2.00	1.504E+02	3.510E+02	4.155E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.455E+03
	4/30 HR15	4/24 HR10	4/24 HR10	4/30 HR15	4/30 HR16	4/30 HR16	4/30 HR16	4/30 HR16	4/30 HR24	4/30 HR13
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24
MTN SUMS	208.80	1.579E+04	3.685E+04	4.132E+04	2.387E+05	1.432E+05	4.774E+04	4.774E+04	0.	1.758E+05
MTN AVGS	.54	4.113E+01	9.596E+01	1.076E+02	6.216E+02	3.729E+02	1.243E+02	1.243E+02	0.	4.579E+02
5										
MTN MAX	2.00	1.498E+02	3.495E+02	4.249E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.541E+03
	5/31 HR15	5/21 HR 8	5/21 HR 8	5/15 HR15	5/31 HR16	5/31 HR16	5/31 HR16	5/31 HR16	5/31 HR24	5/29 HR12
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24
MTN SUMS	382.80	2.848E+04	6.645E+04	7.733E+04	4.410E+05	2.646E+05	8.820E+04	8.820E+04	0.	3.777E+05
MTN AVGS	.51	3.828E+01	8.932E+01	1.039E+02	5.927E+02	3.556E+02	1.185E+02	1.185E+02	0.	5.076E+02
6										
MTN MAX	2.00	1.466E+02	3.422E+02	4.352E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.559E+03
	6/19 HR15	6/17 HR 8	6/17 HR 8	6/10 HR 8	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR24	6/18 HR13
MTN MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24
MTN SUMS	226.20	1.594E+04	3.720E+04	4.866E+04	2.620E+05	1.572E+05	5.239E+04	5.239E+04	0.	2.522E+05
MTN AVGS	.50	3.496E+01	8.157E+01	1.067E+02	5.245E+02	3.447E+02	1.149E+02	1.149E+02	0.	5.530E+02
YR MAX	2.00	1.504E+02	3.510E+02	4.352E+02	1.700E+03	1.020E+03	3.400E+02	3.400E+02	0.	1.559E+03
	6/19 HR15	4/24 HR10	4/24 HR10	6/10 HR 8	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR16	6/19 HR24	6/18 HR13
YR MIN	0.00	0.	0.	0.	8.500E+01	5.100E+01	1.700E+01	1.700E+01	0.	0.
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24
YR SUMS	817.80	6.021E+04	1.405E+05	1.673E+05	9.416E+05	5.650E+05	1.883E+05	1.883E+05	0.	8.057E+05
YR AVGS	.52	3.901E+01	8.870E+01	1.056E+02	5.945E+02	3.567E+02	1.189E+02	1.189E+02	0.	5.086E+02

EOI ENCOUNTERED.  
C)

Figure B7. (Cont'd)



1 BEGIN REPORT 3  
 2 TITLE = "SAMPLE DAILY PLANT REPORT"  
 3 RUN = FROM 03APR THRU 05APR  
 4 FOR PLANTS REPORT  
 5 DAILY  
 6 END REPORT

\*\*\*REPORT START DATE PRECEDED REPORT FILE START DATE, RESET TO REPORT START DATE OF 15/ 4/68 (DD/MM/YY)

\*\*\*REPORT END DATE PRECEEDS REPORT START DATE. RESET TO REPORT START DATE OF 15/ 4/68 (DD/MM/YY)

7 BEGIN REPORT 2

# SAMPLE DAILY PLANT REPORT

ENVIRONMENT 3 PLANT 4 DAILY FROM 4/15/1968 THRU 4/15/1968

DAY	FANHEATD 1000BTU	FANCOOLD 1000BTU	FANELECD 1000BTU	FANFUELD 1000BTU	EQ DEMAND 1000BTU	EQ LOADMET 1000BTU	EQ PURNET 1000BTU
15							
MAXIMUMS	5.558E+01	3.891E+01	9.655E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
4/15 HR 8	4/15 HR16	4/15 HR17	4/15 HR24	0/ 0 HR 0	0/ 0 HR 0	0/ 0 HR 0	0/ 0 HR 0
MINIMUMS	2.260E+01	1.780E+01	3.195E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
4/15 HR 1	4/15 HR 6	4/15 HR24	4/15 HR24	0/ 0 HR 0	0/ 0 HR 0	0/ 0 HR 0	0/ 0 HR 0
SUMS	8.484E+02	7.149E+02	1.453E+02	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
AVERAGES	3.535E+01	2.979E+01	6.056E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*

MTM MAX	5.558E+01	3.891E+01	9.655E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
4/15 HR 8	4/15 HR16	4/15 HR17	4/15 HR24	0/ 0 HR 0	0/ 0 HR 0	0/ 0 HR 0	0/ 0 HR 0
MTM MIN	2.260E+01	1.780E+01	3.195E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
4/15 HR 1	4/15 HR 6	4/15 HR24	4/15 HR24	0/ 0 HR 0	0/ 0 HR 0	0/ 0 HR 0	0/ 0 HR 0
MTM SUMS	8.484E+02	7.149E+02	1.453E+02	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
MTM AVGS	3.535E+01	2.979E+01	6.056E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*

\*SPECIAL\* - VARIABLE CODE REFERENCES A MULTIPLE ITEM DATA SET REQUIRING A SPECIAL REPORT FOR ACCESS.

Figure B8. Examples.

8 RUN = COLUMBIA SUMMER;  
 9 TITLE = "SAMPLE SYSTEM REPORT FOR 1 DESIGN DAY"  
 10 FOR SYSTEMS = 72 REPORT VARIABLES = 1,2,3,4,5,6,10,11,25  
 11 END REPORT  
 12 BEGIN REPORT 1

## SAMPLE SYSTEM REPORT FOR 1 DESIGN DAY

ENVIRONMENT 2 SYSTEM 72 HOURLY FROM 7/21/1980 THRU 7/21/1980

HOURL	INAIR CC DEG. F	INHUHR CC	OUTAIR CC DEG. F	OUTHUHR CC	AIR MFR CC LB/HR	TOT COL LD 1000BTU	AIR MFR HC LB/HR	TOTHEATLD 1000BTU	EXFANPUR 1000BTU
1	69.69	.0083	51.66	.0081	7.383E+03	3.368E+04	1.606E+03	2.976E+04	*NODATA*
2	69.63	.0083	51.64	.0081	7.388E+03	3.394E+04	1.602E+03	2.970E+04	*NODATA*
3	69.54	.0083	51.66	.0081	7.403E+03	3.358E+04	1.586E+03	2.944E+04	*NODATA*
4	69.53	.0083	51.63	.0081	7.407E+03	3.386E+04	1.582E+03	2.938E+04	*NODATA*
5	69.41	.0083	51.66	.0081	7.421E+03	3.367E+04	1.569E+03	2.916E+04	*NODATA*
6	68.77	.0083	51.64	.0081	7.468E+03	3.236E+04	1.522E+03	2.852E+04	*NODATA*
7	68.34	.0082	51.49	.0081	7.490E+03	3.211E+04	1.500E+03	2.827E+04	*NODATA*
8	67.17	.0081	51.46	.0081	7.578E+03	2.919E+04	1.412E+03	2.701E+04	*NODATA*
9	66.48	.0080	51.13	.0080	7.605E+03	2.879E+04	1.385E+03	2.672E+04	*NODATA*
10	65.75	.0079	51.09	.0079	7.659E+03	2.736E+04	1.331E+03	2.591E+04	*NODATA*
11	65.42	.0077	50.93	.0077	7.674E+03	2.708E+04	1.316E+03	2.572E+04	*NODATA*
12	65.99	.0076	50.90	.0076	7.630E+03	2.804E+04	1.360E+03	2.639E+04	*NODATA*
13	66.29	.0075	51.00	.0075	7.618E+03	2.836E+04	1.372E+03	2.652E+04	*NODATA*
14	66.37	.0073	51.04	.0073	7.618E+03	2.843E+04	1.371E+03	2.649E+04	*NODATA*
15	66.91	.0072	51.05	.0072	7.586E+03	2.928E+04	1.404E+03	2.694E+04	*NODATA*
16	67.09	.0070	51.14	.0070	7.581E+03	2.940E+04	1.409E+03	2.698E+04	*NODATA*
17	67.20	.0069	51.16	.0069	7.575E+03	2.956E+04	1.414E+03	2.704E+04	*NODATA*
18	66.47	.0067	51.18	.0067	7.634E+03	2.839E+04	1.355E+03	2.615E+04	*NODATA*
19	65.93	.0065	51.04	.0065	7.672E+03	2.776E+04	1.318E+03	2.559E+04	*NODATA*
20	65.55	.0064	50.97	.0064	7.694E+03	2.725E+04	1.296E+03	2.529E+04	*NODATA*
21	64.84	.0063	50.91	.0063	7.744E+03	2.620E+04	1.245E+03	2.452E+04	*NODATA*
22	64.28	.0062	50.80	.0062	7.779E+03	2.549E+04	1.210E+03	2.399E+04	*NODATA*
23	63.92	.0061	50.72	.0061	7.809E+03	2.504E+04	1.181E+03	2.351E+04	*NODATA*
24	63.25	.0060	50.67	.0060	7.860E+03	2.403E+04	1.130E+03	2.267E+04	*NODATA*
MAXIMUMS	69.69	.0083	51.66	.0081	7.860E+03	3.386E+04	1.606E+03	2.976E+04	*NODATA*
7/21 HR 1			7/21 HR 5	7/21 HR 5	7/21 HR24	7/21 HR 4	7/21 HR 1	7/21 HR 1	0/ 0 HR 0
MINIMUMS	63.25	.0060	50.67	.0060	7.383E+03	2.403E+04	1.130E+03	2.267E+04	*NODATA*
7/21 HR24			7/21 HR24	7/21 HR24	7/21 HR 1	7/21 HR24	7/21 HR24	7/21 HR24	0/ 0 HR 0
SUMS	1603.82	.1774	1228.56	.1761	1.823E+05	7.027E+05	3.348E+04	6.417E+05	*NODATA*
AVERAGES	66.83	.0074	51.19	.0073	7.595E+03	2.928E+04	1.395E+03	2.674E+04	*NODATA*

\*NODATA\* - NO DATA FOR THIS VARIABLE CODE EXISTS ON THE FILE.

Figure B8. (Cont'd).

13 TITLE = "SAMPLE MONTHLY ZONE REPORT"

14 FOR ZONES = 1,3 REPORT VARIABLES = 2,3,4,5,6,25,1004,1006,1009

15 MONTHLY

16 END REPORT

\*\*\*\*REPORT END DATE EXCEEDS REPORT FILE END DATE. RESET TO REPORT FILE END DATE OF 19/ 6/68 (DD/MM/YY)

\*\*\*\*REPORT START DATE PRECEDED REPORT FILE START DATE. RESET TO REPORT START DATE OF 15/ 4/68 (DD/MM/YY)

17 BEGIN REPORT 3

## SAMPLE MONTHLY ZONE REPORT

ENVIRONMENT 3 ZONE 1 MONTHLY FROM 4/15/1968 THRU 6/19/1968

MONTH	DOCCUPANTS	CONHEATCC	RADHEATCC	LATHEATCC	ELECDMDLTS	OTSOLAR+	ZNRAIRMTL	ZNELECLD	ZONE TEMP
	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	DEG. F
4									
MTH MAX	2.00	1.504E+02	3.509E+02	4.157E+02	1.700E+03	1.699E+03	0.	1.700E+03	76.29
	4/30 HR15	4/24 HR 9	4/24 HR 9	4/17 HR16	4/30 HR16	4/15 HR13	4/30 HR24	4/30 HR16	4/30 HR17
MTH MIN	0.00	0.	0.	0.	8.500E+01	0.	0.	8.500E+01	61.80
	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/24 HR 6
MTH SUMS	208.80	1.578E+04	3.683E+04	4.135E+04	2.387E+05	1.871E+05	0.	2.387E+05	26757.98
MTH AVGS	.54	4.111E+01	9.591E+01	1.077E+02	6.216E+02	4.873E+02	0.	6.216E+02	69.68
5									
MTH MAX	2.00	1.499E+02	3.498E+02	4.249E+02	1.700E+03	1.541E+03	0.	1.700E+03	80.67
	5/31 HR15	5/21 HR 8	5/21 HR 8	5/15 HR15	5/31 HR16	5/29 HR12	5/31 HR24	5/31 HR16	5/ 2 HR17
MTH MIN	0.00	0.	0.	0.	8.500E+01	0.	0.	8.500E+01	61.92
	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/19 HR 9
MTH SUMS	382.80	2.848E+04	6.646E+04	7.733E+04	4.410E+05	3.718E+05	0.	4.410E+05	53036.45
MTH AVGS	.51	3.828E+01	8.933E+01	1.039E+02	5.927E+02	4.997E+02	0.	5.927E+02	71.29
6									
MTH MAX	2.00	1.468E+02	3.425E+02	4.325E+02	1.700E+03	1.559E+03	0.	1.700E+03	85.55
	6/19 HR15	6/17 HR 8	6/17 HR 8	6/10 HR15	6/19 HR16	6/18 HR13	6/19 HR24	6/19 HR16	6/ 9 HR19
MTH MIN	0.00	0.	0.	0.	8.500E+01	0.	0.	8.500E+01	71.50
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/ 1 HR 8
MTH SUMS	226.20	1.595E+04	3.723E+04	4.862E+04	2.620E+05	2.390E+05	0.	2.620E+05	35783.53
MTH AVGS	.50	3.499E+01	8.164E+01	1.066E+02	5.745E+02	5.241E+02	0.	5.745E+02	78.47
YR MAX	2.00	1.504E+02	3.509E+02	4.325E+02	1.700E+03	1.699E+03	0.	1.700E+03	85.55
	6/19 HR15	4/24 HR 9	4/24 HR 9	6/10 HR15	6/19 HR16	4/15 HR13	6/19 HR24	6/19 HR16	6/ 9 HR19
YR MIN	0.00	0.	0.	0.	8.500E+01	0.	0.	8.500E+01	61.80
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	4/24 HR 6
YR SUMS	817.80	6.022E+04	1.405E+05	1.673E+05	9.416E+05	7.979E+05	0.	9.416E+05	115577.95
YR AVGS	.52	3.802E+01	8.871E+01	1.05.E+02	5.945E+02	5.037E+02	0.	5.945E+02	72.99

Figure B8. (Cont'd).

## SAMPLE MONTHLY ZONE REPORT

ENVIRONMENT 3 ZONE 3 MONTHLY FROM 4/15/1968 THRU 6/19/1968

MONTH	BOCCUPANTS	CONHEATOC	RADHEATOC	LATHEATOC	ELECDMDLTS	TOTSOLAR*	ZNRAIRHTL	ZNELECLD	ZONE TEMP
	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	1000BTU	DEG. F
4									
MTM MAX	2.00	1.499E+02	3.478E+02	4.185E+02	1.700E+03	1.455E+03	0.	1.700E+03	77.08
	4/30 HR15	4/24 HR 9	4/24 HR 9	4/17 HR16	4/30 HR16	4/30 HR13	4/30 HR24	4/30 HR16	4/30 HR17
MTM MIN	0.00	0.	0.	0.	8.500E+01	0.	0.	8.500E+01	61.87
	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/30 HR24	4/24 HR 6
MTM SUMS	208.80	1.572E+04	3.668E+04	4.157E+04	2.387E+05	1.758E+05	0.	2.387E+05	27024.76
MTM AVGS	.54	4.093E+01	9.551E+01	1.083E+02	6.216E+02	4.578E+02	0.	6.216E+02	70.38
5									
MTM MAX	2.00	1.498E+02	3.495E+02	4.254E+02	1.700E+03	1.541E+03	0.	1.700E+03	80.52
	5/31 HR15	5/20 HR 8	5/20 HR 8	5/15 HR15	5/31 HR16	5/29 HR12	5/31 HR24	5/31 HR16	5/ 2 HR17
MTM MIN	0.00	0.	0.	0.	8.500E+01	0.	0.	8.500E+01	61.99
	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/31 HR24	5/19 HR 9
MTM SUMS	382.80	2.838E+04	6.621E+04	7.768E+04	4.410E+05	3.768E+05	0.	4.410E+05	53512.05
MTM AVGS	.51	3.014E+01	8.899E+01	1.044E+02	5.927E+02	5.064E+02	0.	5.927E+02	71.92
6									
MTM MAX	2.00	1.465E+02	3.419E+02	4.335E+02	1.700E+03	1.559E+03	0.	1.700E+03	85.55
	6/19 HR15	6/17 HR 8	6/17 HR 8	6/10 HR 8	6/19 HR16	6/18 HR13	6/19 HR24	6/19 HR16	6/ 9 HR19
MTM MIN	0.00	0.	0.	0.	8.500E+01	0.	0.	8.500E+01	71.75
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/ 2 HR 6
MTM SUMS	226.20	1.601E+04	3.736E+04	4.842E+04	2.620E+05	2.510E+05	0.	2.620E+05	35628.21
MTM AVGS	.50	3.511E+01	8.193E+01	1.062E+02	5.745E+02	5.503E+02	0.	5.745E+02	78.13
YR MAX	2.00	1.499E+02	3.498E+02	4.335E+02	1.700E+03	1.559E+03	0.	1.700E+03	85.55
	6/19 HR15	4/24 HR 9	4/24 HR 9	6/10 HR 8	6/19 HR16	6/18 HR13	6/19 HR24	6/19 HR16	6/ 9 HR19
YR MIN	0.00	0.	0.	0.	8.500E+01	0.	0.	8.500E+01	61.87
	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	6/19 HR24	4/24 HR 6
YR SUMS	817.80	6.011E+04	1.402E+05	1.677E+05	9.416E+05	8.035E+05	0.	9.416E+05	116165.02
YR AVGS	.52	3.795E+01	8.854E+01	1.059E+02	5.945E+02	5.073E+02	0.	5.945E+02	73.34

18 TITLE = "SAMPLE YEARLY PLANT RUN"

19 RUN = ALL ENVIRONMENTS

20 FOR PLANTS REPORT

21 YEARLY

22 END REPORT

\*\*\*\*REPORT END DATE EXCEEDS REPORT FILE END DATE. RESET TO REPORT FILE END DATE OF 19/ 6/68 (DD/MM/YY)

\*\*\*\*REPORT START DATE PRECEDED REPORT FILE START DATE. RESET TO REPORT START DATE OF 15/ 4/68 (DD/MM/YY)

23 BEGIN REPORT 8

Figure B8. (Cont'd).

## SAMPLE YEARLY PLANT RUN

ENVIRONMENT 1 PLANT		4 YEARLY FROM 1/21/1980 THRU 1/21/1980					
YEAR	FANHEATD 1000BTU	FANCOOLD 1000BTU	FANELED 1000BTU	FANFUELD 1000BTU	EQ DEMAND 1000BTU	EQ LOADMET 1000BTU	EQ PURMET 1000BTU
1980							
YR MAX	4.643E+01 1/21 HR 6	1.944E+01 1/21 HR15	3.195E+00 1/21 HR24	0. 1/21 HR24	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0
YR MIN	3.468E+01 1/21 HR15	1.634E+01 1/21 HR 5	3.195E+00 1/21 HR24	0. 1/21 HR24	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0
YR SUMS	9.876E+02	4.245E+02	7.667E+01	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
YR AVGS	4.115E+01	1.769E+01	3.195E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*

## SAMPLE YEARLY PLANT RUN

ENVIRONMENT 2 PLANT		4 YEARLY FROM 7/21/1980 THRU 7/21/1980					
YEAR	FANHEATD 1000BTU	FANCOOLD 1000BTU	FANELED 1000BTU	FANFUELD 1000BTU	EQ DEMAND 1000BTU	EQ LOADMET 1000BTU	EQ PURMET 1000BTU
1980							
YR MAX	2.976E+01 7/21 HR 1	3.386E+01 7/21 HR 4	3.195E+00 7/21 HR24	0. 7/21 HR24	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0
YR MIN	2.267E+01 7/21 HR24	2.403E+01 7/21 HR24	3.195E+00 7/21 HR24	0. 7/21 HR24	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0
YR SUMS	6.417E+02	7.027E+02	7.667E+01	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
YR AVGS	2.674E+01	2.928E+01	3.195E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*

Figure B8. (Cont'd).

## SAMPLE YEARLY PLANT RUN

ENVIRONMENT 3 PLANT 4 YEARLY FROM 4/15/1968 THRU 6/19/1968

YEAR	FANHEATD 1000BTU	FANCOOLD 1000BTU	FANELECD 1000BTU	FANFUELD 1000BTU	EQ DEMAND 1000BTU	EQ LOADMET 1000BTU	EQ PURNET 1000BTU
1968							
YR MAX	5.758E+01 4/24 HR 8	6.370E+01 6/10 HR13	9.655E+00 6/19 HR16	0. 6/19 HR24	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0
YR MIN	2.047E+01 6/10 HR15	1.740E+01 4/24 HR 6	3.195E+00 6/19 HR24	0. 6/19 HR24	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0	*SPECIAL* 0/ 0 HR 0
YR SUNS	5.412E+04	6.041E+04	8.288E+03	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*
YR AVGS	3.417E+01	3.814E+01	5.232E+00	0.	*SPECIAL*	*SPECIAL*	*SPECIAL*

\*SPECIAL\* - VARIABLE CODE REFERENCES A MULTIPLE ITEM DATA SET REQUIRING A SPECIAL REPORT FOR ACCESS.

24 END REPORT

Figure B8. (Cont'd).

## SURFACE VERTICES OF ZONE 1- LEFT END UNIT

## #5 DPG COORDINATES (FEET)

1 ABS	(	0.0,	0.0,	8.0)	(	0.0,	0.0,	0.0)	(	12.0,	0.0,	0.0)	(	12.0,	0.0,	8.0)
2 REL	(	2.0,	6.0,	0.0)	(	2.0,	2.0,	0.0)	(	10.0,	2.0,	0.0)	(	10.0,	6.0,	0.0)
3 REL	(	0.0,	8.0,	3.0)	(	0.0,	8.0,	0.0)	(	12.0,	8.0,	0.0)	(	12.0,	8.0,	3.0)
4 ABS	(	0.0,	25.0,	8.0)	(	0.0,	25.0,	0.0)	(	0.0,	0.0,	0.0)	(	0.0,	0.0,	8.0)
5 ABS	(	12.0,	0.0,	8.0)	(	12.0,	0.0,	0.0)	(	12.0,	25.0,	0.0)	(	12.0,	25.0,	8.0)
6 ABS	(	12.0,	25.0,	8.0)	(	12.0,	25.0,	0.0)	(	0.0,	25.0,	0.0)	(	0.0,	25.0,	8.0)
7 ABS	(	0.0,	25.0,	8.0)	(	0.0,	0.0,	8.0)	(	12.0,	0.0,	8.0)	(	12.0,	25.0,	8.0)
8 ABS	(	0.0,	0.0,	0.0)	(	0.0,	25.0,	0.0)	(	12.0,	25.0,	0.0)	(	12.0,	0.0,	0.0)

## SURFACE VERTICES OF ZONE 2- LOWER MIDDLE UNIT

## #5 ORG COORDINATES (FEET)

9 ABS	(	12.0,	25.0,	8.0)	(	12.0,	0.0,	8.0)	(	24.0,	0.0,	8.0)	(	24.0,	25.0,	8.0)
10 ABS	(	12.0,	0.0,	0.0)	(	12.0,	25.0,	0.0)	(	24.0,	25.0,	0.0)	(	24.0,	0.0,	0.0)
11 ABS	(	12.0,	0.0,	8.0)	(	12.0,	0.0,	0.0)	(	24.0,	0.0,	0.0)	(	24.0,	0.0,	8.0)
12 REL	(	2.0,	6.0,	0.0)	(	2.0,	2.0,	0.0)	(	10.0,	2.0,	0.0)	(	10.0,	6.0,	0.0)
13 REL	(	0.0,	8.0,	3.0)	(	0.0,	8.0,	0.0)	(	12.0,	8.0,	0.0)	(	12.0,	8.0,	3.0)
14 ABS	(	24.0,	25.0,	8.0)	(	24.0,	25.0,	0.0)	(	12.0,	25.0,	0.0)	(	12.0,	25.0,	8.0)
15 ABS	(	24.0,	0.0,	8.0)	(	24.0,	0.0,	0.0)	(	24.0,	25.0,	0.0)	(	24.0,	25.0,	8.0)
16 ABS	(	12.0,	25.0,	8.0)	(	12.0,	25.0,	0.0)	(	12.0,	0.0,	0.0)	(	12.0,	0.0,	8.0)

## SURFACE VERTICES OF ZONE 3- UPPER MIDDLE UNIT

## #5 ORG COORDINATES (FEET)

17 ABS	(	24.0,	30.0,	8.0)	(	24.0,	55.0,	8.0)	(	12.0,	55.0,	8.0)	(	12.0,	30.0,	8.0)
18 ABS	(	24.0,	55.0,	0.0)	(	24.0,	30.0,	0.0)	(	12.0,	30.0,	0.0)	(	12.0,	55.0,	0.0)
19 ABS	(	24.0,	55.0,	8.0)	(	24.0,	55.0,	0.0)	(	12.0,	55.0,	0.0)	(	12.0,	55.0,	8.0)
20 REL	(	2.0,	6.0,	0.0)	(	2.0,	2.0,	0.0)	(	10.0,	2.0,	0.0)	(	10.0,	6.0,	0.0)
21 REL	(	0.0,	8.0,	3.0)	(	0.0,	8.0,	0.0)	(	12.0,	8.0,	0.0)	(	12.0,	8.0,	3.0)
22 ABS	(	12.0,	30.0,	8.0)	(	12.0,	30.0,	0.0)	(	24.0,	30.0,	0.0)	(	24.0,	30.0,	8.0)
23 ABS	(	12.0,	55.0,	8.0)	(	12.0,	55.0,	0.0)	(	12.0,	30.0,	0.0)	(	12.0,	30.0,	8.0)
24 ABS	(	24.0,	30.0,	8.0)	(	24.0,	30.0,	0.0)	(	24.0,	55.0,	0.0)	(	24.0,	55.0,	8.0)

## SURFACE VERTICES OF ZONE 4- UPPER OUTSIDE UNIT

## #5 ORG COORDINATES (FEET)

25 ABS	(	12.0,	30.0,	8.0)	(	12.0,	55.0,	8.0)	(	0.0,	55.0,	8.0)	(	0.0,	30.0,	8.0)
26 ABS	(	12.0,	55.0,	0.0)	(	12.0,	30.0,	0.0)	(	0.0,	30.0,	0.0)	(	0.0,	55.0,	0.0)
27 ABS	(	12.0,	55.0,	8.0)	(	12.0,	55.0,	0.0)	(	0.0,	55.0,	0.0)	(	0.0,	55.0,	8.0)
28 REL	(	2.0,	6.0,	0.0)	(	2.0,	2.0,	0.0)	(	10.0,	2.0,	0.0)	(	10.0,	6.0,	0.0)
29 ABS	(	0.0,	55.0,	8.0)	(	0.0,	55.0,	0.0)	(	0.0,	30.0,	0.0)	(	0.0,	30.0,	8.0)
30 ABS	(	12.0,	30.0,	8.0)	(	12.0,	30.0,	0.0)	(	12.0,	55.0,	0.0)	(	12.0,	55.0,	8.0)
31 ABS	(	0.0,	30.0,	8.0)	(	0.0,	30.0,	0.0)	(	12.0,	30.0,	0.0)	(	12.0,	30.0,	8.0)

EOI ENCOUNTERED.

C)

Figure B8. (Cont'd).

## GLOSSARY

This glossary of variables is in the following format:

VARIABLE (section, number): definition of the variable

where:

VARIABLE = the 10-character abbreviation for the variable  
which appears in the reports generated by  
the BLAST Report Writer

section = the segment of BLAST to which the data apply

ZN = loads section

SY = systems section

SZ = zone in systems section

PL = plant section

number = variable number as shown in Figure B1.

#OCCUPANTS (ZN,2) : the actual number of occupants in the zone.

AIR MFR CC (SY,5) : mass flow rate of air through the cooling coil.

AIR MFR HC (SY,10) : mass flow rate of air through the heating coil.

CONBASEHTL (ZN,22) : amount of outdoor temperature controlled  
baseboard heating load which is convected  
to the zone.

CONHEATEEQ (ZN,12) : amount of the heat gain from electrical equipment  
which is convected to the zone.

CONHEATGEQ (ZN,16) : amount of the heat gain from gas equipment  
which is convected to the zone.

CONHEATLTS (ZN,7) : amount of the heat gain from lights which is  
convected into the zone.

CONHEATOCC (ZN,3) : amount of the heat gain from people which is  
convected into the zone.

CONHEATOTH (ZN,19) : amount of the heat gain from other equipment  
which is convected into the zone.

DBWASTE (PL,28) : the amount of heat which was recoverable by the  
double-bundle chiller, but was not recovered  
because no demand existed for it.

DESSUPAIRT (SZ,6) : the required supply air dry-bulb temperature  
needed to satisfy the zone's heating and cooling  
requirements.



EEQ PWRMET (PL,55) : the electrical power consumed by each equipment type installed in the plant.

ELECDHWMMD (PL,43) : the domestic hot water demand to be met by an electric boiler and/or solar system.

ELECDMDDX (SY,19) : the electrical demand of the DX condensing unit.

ELECDMDHRD (SY,20) : the electrical demand of the air-to-air heat recovery device.

ELECDMDLTS (ZN,6) : the electrical demand from lights for the zone.

ELECDMDEEQ (ZN,11) : the electrical demand from electrical equipment for the zone.

EQ DEMAND (PL,53) : the demand on each equipment type installed in the plant.

EQ LOADMET (PL,54) : the load met by each equipment type installed in the plant.

EQ OP CAP (PL,52) : the operating capacity of each equipment type.

EQ SIZE OP (PL,57) : the number of each size of each equipment type which is operating.

EQFUELUSED (PL,56) : the amount of in-plant fuel consumed by each equipment type in the plant.

EXAIR MFR (SZ,11) : the exhaust air mass flow rate for the zone.

EXFANPWR (SY,25) : the total exhaust fan power for all zones on the system.

FANCOOLD (PL,2) : the total chilled water demand from all the fan systems served by the plant.

FANELECD (PL,3) : the total electrical demand from all the fan systems served by the plant.

FANFUELD (PL,4) : the total fuel (gas) demand from all the fan systems served by the plant.

FANHEATD (PL,1) : the total heating demand from all the fan systems served by the plant.

FINAL HUMR (SZ,12) : the zone humidity ratio at the end of the current hour.

GASDHWMMD (PL,42) : the domestic hot water demand to be met by a fuel boiler and/or solar system.

GASDMDGEQ (ZN,15) : the fuel (gas) demand for each zone resulting

from gas equipment in the zone.

- HEATAVAIL (PL,11) : amount of high-quality (level 5) heat available for storage in the plant.
- HEATRECDDB (PL,27) : amount of heat recovered by the double-bundle chillers.
- HEATRECDCE (PL,21) : amount of exhaust heat recovered from the diesel-driven chillers.
- HEATRECDGJ (PL,24) : amount of jacket heat recovered from the diesel-driven chillers.
- HEATRECDCL (PL,23) : amount of lube heat recovered from the diesel-driven chillers.
- HEATRECDDE (PL,14) : amount of exhaust heat recovered from the diesel generators.
- HEATRECDJ (PL,17) : amount of jacket heat recovered from the diesel generators.
- HEATRECDL (PL,16) : amount of lube heat recovered from the diesel generators.
- HEATRECECSC (PL,26) : amount of heat recovered from the extraction steam turbine-driven chillers.
- HEATRECEST (PL,19) : amount of heat recovered from the extraction steam turbine generators.
- HEATRECGCE (PL,20) : amount of exhaust heat recovered from the gas turbine-driven chillers.
- HEATRECGCL (PL,22) : amount of lube heat recovered from the gas turbine-driven chillers.
- HEATRECGTE (PL,13) : amount of exhaust heat recovered from the gas turbine generators.
- HEATRECGTL (PL,15) : amount of lube heat recovered from the gas turbine generators.
- HEATRECHP (PL,29) : amount of heat recovered by the heat pumps in the plants.
- HEATRECST (PL,18) : amount of heat recovered from the steam turbine generator.
- HEATRECSTC (PL,25) : amount of heat recovered from the steam turbine-driven chillers.

HEATSTORED (PL,12) : amount of available heat for storage (HEATAVAIL) that is actually stored in a hot storage tank or is used to produce chilled water which is stored in a cold storage tank.

HPWASTE (PL,30) : the amount of heat which was recoverable by the heat pump but was not recovered because no demand existed for it.

HTRECAIR (SY,21) : total heat recovered from relief air in fan system. A positive number indicates heat added to makeup air. A negative number indicates heat removed from makeup air.

HUMADDWATR (SY,18) : amount of water added by the humidifier to air delivered to building.

INAIR CC (SY,1) : air dry-bulb temperature entering the cooling coil.

INAIR HC (SY,7) : air dry-bulb temperature entering the heating coil.

INHUMR CC (SY,2) : humidity ratio of air entering the cooling coil.

INWATERCT (PL,44) : temperature of water entering cooling tower.

INWATEREC (PL,47) : temperature of water entering evaporative condenser.

LATHEATEEQ (ZN,14) : amount of latent heat gain in the zone from electric equipment.

LATHEATGEQ (ZN,18) : amount of latent heat gain in the zone from gas equipment.

LATHEATOCC (ZN,5) : amount of latent heat gain in the zone from occupants.

LATHEATOTH (ZN,21) : amount of latent heat gain in the zone from other equipment.

MEANRADTMP (ZN,24) : mean radiant temperature of the zone.

MIXAIRHUMR (SY,13) : humidity ratio of the air after the mixing box.

MIXAIRROUT (SY,15) : fraction of total mixed air which is outside air.

MIXAIRTEMP (SY,12) : dry-bulb temperature of the air after the mixing box.

MIXAIRTMPD (SY,14) : desired dry-bulb temperature of the air after mixing box which the economy cycle controller tries to achieve.

OUTAIR CC (SY,3) : dry-bulb temperature of air leaving the cooling coil.

OUTAIR HC (SY,8) : dry-bulb temperature of air leaving the heating coil.

OUTHUMR CC (SY,4) : humidity ratio of air leaving the cooling coil.

OUTHUMR HC (SY,9) : humidity ratio of air leaving the heating coil.

OUTHUMRHUM (SY,16) : humidity ratio of air leaving humidifier.

OUTWATERCT (PL,45) : temperature of water leaving the cooling tower.

OUTWATEREC (PL,48) : temperature of water leaving the evaporative condenser.

OUTWATERWW (PL,50) : temperature of water leaving the well-water condenser.

PREHEATCLD (SY,22) : the total load on preheat coil.

PUMPPWRCW (PL,31) : chilled water pump electrical demand.

PUMPPWRHW (PL,32) : hot water pump electrical demand.

PUMPPWRSOL (PL,33) : solar system pump electrical demand.

RADBASEHTL (ZN,23) : amount of outdoor temperature controlled baseboard heating load which is radiated to the zone.

RADHEATEEQ (ZN,13) : amount of the heat gain from electrical equipment which is radiated to the zone.

RADHEATGEQ (ZN,17) : amount of the heat gain from gas equipment which is radiated to the zone.

RADHEATLTS (ZN,8) : amount of the heat gain from lights which is radiated to the zone.

RADHEATOCC (ZN,4) : amount of the heat gain from occupants which is radiated to the zone.

RADHEATOTH (ZN,20) : amount of the heat gain from other equipment  
 which is radiated to the zone.

RECOOLCOIL (SZ,3) : zone recool coil/fancoil cooling demand.

REHEATCOIL (SZ,2) : zone reheat coil/fancoil heating demand.

RETAIR MFR (SZ,10) : total return air mass flow rate for system.

RETAIR+LTS (ZN,10) : return air heat gains from lights to the  
 zone.

RETAIRHUMR (SZ,8) : humidity ratio of the zone return air.

RETAIRTEMP (SZ,7) : dry-bulb temperature of the zone return air.

RETFANPWR (SY,24) : total return fan electrical demand.

SOLCOOL (PL,37) : amount of collected solar energy used to  
 satisfy cooling demands.

SOLDHW (PL,39) : amount of collected solar energy used to satisfy  
 domestic hot water demand.

SOLDRAPES (ZN,26) : amount of solar gain in drapes.

SOLFLOADHP (PL,40) : amount of collected solar energy used to  
 false load the heat pump.

SOLHEAT (PL,38) : amount of collected solar energy used to  
 satisfy heating demands.

SOLWALLS (ZN,27) : amount of solar gain in walls.

SOLWASTE (PL,35) : amount of solar energy which could have been  
 collected, but was not because the solar  
 tank was charged to capacity.

SUPAIR MFR (SZ,9) : the supply air mass flow rate for the zone.

SUPFANPWR (SY,23) : the total supply fan power for the system.

TANKTEMP (PL,36) : the temperature of the solar storage tank at  
 the end of the hour.

THERMBASEH (SZ,1) : the demand for thermostat controlled  
 baseboard heat for the zone.

TOT COL LD (SY,6) : the total chilled water demand of the cooling coil or the total amount of heat removed from the system supply air by the system.

TOT HUMLD (SY,17) : the total energy demand of the humidifier.

TOTCOOLD (PL,6) : the total chilled water demand on the plant.

TOTELECD (PL,7) : the total demand for electricity from the plant, including electrical demands from the building, systems, and plant.

TOTEXAMFR (SY,28) : total exhaust air mass flow rate from the system.

TOTFUELD (PL,8) : the total amount of fuel consumed in the plant.

TOTHEATD (PL,5) : the total amount of heat demand in the plant, including heat from systems and absorption chillers.

TOTHEATLD (SY,11) : the total hot water demand from the heating coil in the system.

TOTHEATREC (PL,9) : total heat recovered by plant from all sources and at all levels.

TOTRETAHUM (SY,29) : return air humidity ratio for system before mixing box.

TOTRETAMFR (SY,27) : total system return air mass flow rate.

TOTRETATMP (SY,30) : return air dry-bulb temperature for system before mixing box.

TOTSOLAR+ (ZN,25) : total solar gain in the zone.

TOTSOLCOL (PL,34) : total energy collectable by the solar system.

TOTSUPAMFR (SY,26) : system total supply air mass flow rate.

TOTWASTE (PL,10) : total amount of waste heat at all levels which was recoverable, but not used in the plant.

UNMET COOL (SZ,5) : the amount of zone cooling load which could not be met by the system.

UNMET HEAT (SZ,4) : the amount of zone heating load which could not be met by the system.

VERTICES (ZN,1) : the coordinates for the vertices of each  
surface in the zone description (not hourly).

VISHEATLTS (ZN,9) : amount of heat gain from lights that are  
visible light.

WATERFRCT (PL,46) : condenser water flow rate through cooling  
tower.

WATERFREC (PL,49) : condenser water flow rate through evaporative  
condenser.

WATERFRWW (PL,51) : water flow rate from well-water condenser.

Herron, Dale

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ATTN: DAEN-CCP  
ATTN: DAEN-ASI-L (2)

Commander  
USAF/AFESC

USAF/AFSC/ASD (5)  
ATTN: Rosenthal

## DOE

Division of Conservation and Solar Applications (5)  
ATTN: Kammarud

## US Army Engineer Districts

ATTN: Library  
Alaska  
Albany  
Albuquerque  
Baltimore  
Buffalo  
Charleston  
Chicago  
Detroit  
Far East  
Fort Worth  
Galveston  
Huntington  
Jacksonville  
Japan  
Jidda  
Kansas City  
Little Rock  
Los Angeles  
Louisville  
Memphis  
Mobile  
New Orleans  
New York  
Norfolk  
Oahu  
Philadelphia  
Portland  
Portland  
Riyadh  
Rock Island  
Sacramento  
San Francisco  
Savannah  
Seattle  
St. Louis  
St. Paul  
Tulsa  
Vicksburg  
Walla Walla  
Wilmington

## US Army Engineer Division

ATTN: Library  
Europe  
Huntsville  
Lower Mississippi Valley  
Middle East  
Middle East (Rear)  
Missouri River  
New England  
North Atlantic  
North Central  
North Pacific  
Ohio River  
Pacific Ocean  
South Atlantic  
South Pacific  
Southwestern

## Waterways Experiment Station

ATTN: Library

## Cold Regions Research Engineering Lab

ATTN: Library

## US Government Printing Office

Receiving Section/Depository Copies (2)

## Defense Technical Information Center

ATTN: DDA (12)

## Engineering Societies Library

New York, NY

FESA, ATTN: Library

ETL, ATTN: Library

Engr. Studies Center, ATTN: Library

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Commander

NCEL

Norton AFB, ATTN: AFPCF-MX/DEE